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William Tyler Olcott

By DAVID B. PICKERING

William Tyler Olcott passed away on the evening of July 6, 1936. Far and wide this message brought sorrow to hundreds of homes. To those in many lands this kindly, patient man had been an inspiration and a guide. He was one of those rare souls who loved the stars with an almost religious fervor. His chief purpose was the propagation of astronomical interest.

Somehow I feel sure that, if Tyler Olcott could have chosen the manner of his passing, he would not have had it other than it was. Only a few days before his death, he and Mrs. Olcott went to George's Mills, New Hampshire, on Lake Sunapee, for their summer vacation. On the evening of July 6, he was giving one of his familiar talks on the stars to a group of summer residents in the local Methodist Church when the heart attack came and he passed quietly away. His funeral was held on the afternoon of July 10, in Norwich, Connecticut, at Christ Episcopal Church, of which he was Senior Warden.

Mr. Olcott was born in Chicago, January 11, 1873, the son of William Marvin Olcott and E. Olivia Tyler Olcott. The family moved to the ancestral Tyler home in Norwich, Connecticut, when he was a boy, and the ancient, colonial residence at 62 Church Street was his home for the rest of his life. He was graduated from Trinity College at Hartford, Connecticut, and was a member of Delta Kappa Epsilon fraternity. Later he attended the New York Law School and was admitted to practice before the bars of New York and Connecticut. In 1902 he married Miss Clara Hyde of Yantic, Connecticut, who survives him.

Their life together was one of constant devotion and undivided interest.

Tyler Oclott was never a robust man, and for years he had suffered from bronchial affections that necessitated winter sojourns in the south. During recent years Mr. and Mrs. Olcott spent many of their winters in Florida and while there Mr. Olcott gave himself to the rehabilitation of the Southern Cross Astronomical Society, writing and lecturing and aiding in operating the many telescopes which the society maintained for the benefit of the public at Miami. It was there that he published a little booklet called "The Southern Cross" that has had a wide circulation. Other winters spent in Arizona and California brought him in close affiliation with the members of the staffs of the Lowell and Steward Observatories as well as those of Mt. Wilson and Lick.

Frequent trips to foreign countries enabled Mr. Olcott to visit num-

erous centers of astronomical interest and make valuable contacts with noted individuals in the field of the science to which he was devoted. His time seemed ever to be spent in writing, lecturing, and corresponding with a host of active and prospective observers. Mrs. Olcott gave herself wholly to guarding his health and assisting him in his work.

For years the Olcotts maintained a summer home on Block Island. There, in the summer of 1905, a girlhood friend of Mrs. Olcott, Miss Helen Clarke, first acquainted Tyler with the formations of the stellar constellations. His interest in astronomy once awakened, he made an intensive study of the subject and in 1907 appeared the first edition of his now famous book "A Field Book of the Stars." This little volume, published by Putnam and Sons, has been several times revised and has probably achieved a wider distribution than any similar work of its kind. This was followed in time by "In Starland with a Three-inch Telescope," "Star Lore of All Ages," "Sun Lore of All Ages," "The Book of the Stars for Young People," and "Field Book of the Skies." The latter, published in 1931, gives promise of being the most successful of them all. There are members of certain groups of amateur astronomers who refer to this latter work as their "Bible." At the time of his death Mr. Olcott had about completed two other works, to which, during recent months, he had devoted the same enthusiastic energy and singleness of purpose that entered into every task he undertook. These are "A Field Book of the Southern Stars" and "The Glory of the Heavens." The first was intended to supply a long-felt want for those interested in observing southern skies, about which we have all too little popular information. The second is a large folio containing many reproductions of the best known photographs of celestial objects. It is to be hoped that both these desirable books will soon be placed upon the market.

Verse had always held a peculiar fascination for Tyler Olcott. He was a student of its classical forms, an ardent admirer of Austin Dobson and the later Victorian poets. The ultra-modernists never appealed to him. He loved the sonnet form the best and gave much time to the composition of these as well as those of more complicated construction. In the "Conning Tower" of the New York Herald-Tribune, not long ago, was published a sestina of Olcott's entitled "Carpe Diem," a splendid example of this most difficult form of verse. Among his unpublished works is an Anthology of Astronomical Poetry, the compilation of which represents an unthinkable amount of laborious research.

It was in 1910 that Mr. Olcott first met Professor Edward C. Pickering, during a visit to the Harvard College Observatory. The Director stressed the great need of astronomers for more observational data on the long period variable stars and explained how the organization of amateur work in this line could be made to supply the desired material. Olcott at once sensed the fact that here was something that would appeal to a host of amateur telescopists—something that would enable

them to take part in organized scientific research and make valuable contributions to the rapidly accumulating knowledge of astronomy. Within a year he had brought together seven men who formed the nucleus of what was to become the largest organized force in the world devoted to the observation of variable stars. For seven years The American Association of Variable Star Observers worked freely under Olcott's personal guidance and supervision. He alone made and distributed the required charts, devised methods for finding the fields and making estimates of the brilliancy of the variables and for reporting the observations to the Harvard College Observatory. He gave individual instruction and carried on an exhaustive correspondence with the constantly growing membership. Furthermore he prepared the reports which from the first were published monthly in POPULAR ASTRONOMY.

The first meeting of the group occurred at an informal dinner held in the fall of 1914 at the Hotel Lorraine in New York City, where some ten enthusiastic members met and discussed their labors. In October, 1915, the first regular annual meeting was held at the Harvard College Observatory, with about 15 members present. When, in 1917, the association was incorporated under the laws of Massachusetts, Tyler Olcott was made Life Secretary of the organization he had founded. The rapid and steady growth of the association, with the consequent increasing accumulation of valuable observations, was ever a source of wonder and delight to its founder. In every one of the innumerable letters of inquiry that he received from all parts of the world, he pictured the writer as a potential observer who could be trained to add his mite to the mass of data being supplied to the Harvard Observatory. Each letter was answered with patient thoughtfulness, describing the requirements of the work and the methods to be followed, giving advice and encouragement. It was Olcott's boast that no letter remained unanswered longer than 24 hours. Filed away in my home are over a thousand such letters in his neat, precise handwriting covering an unbroken correspondence of 22 years. It began with a letter from me to this stranger in Connecticut, inquiring what serious work could be done by an amateur with a small telescope. It developed into an intimate, life-long friendship.

Professor Pickering died in 1919 and Tyler Olcott realized that the A.A.V.S.O. had entered upon a critical period in its progress. The "Big Brother," upon whom so much had depended, was gone, and though Professor Solon I. Bailey as Acting Director of the observatory and Mr. Leon Campbell upon whom Tyler Olcott ever leaned for professional support and encouragement, were wholly sympathetic to the program as it was then being followed, no one could forsee what the attitude of a new Director might be. When, in 1921, the appointment of Dr. Harlow Shapley as Director was announced, Tyler Olcott's relief was manifest. Certainly no man could have been more in sympathy with the aims of the A.A.V.S.O. or more ready to welcome its affiliation

with the work of the observatory than was Dr. Shapley.

Mr. Olcott, more than any other, was responsible for the fact that the association had grown in recent years to over 300 members, located in many countries of the world and contributing hundreds of thousands of observations to Harvard College Observatory.

Mr. Olcott was a life member of the American Astronomical Society, the British Astronomical Association, and the Société Astronomique de France. He had been honored for his work by being made a Fellow of the Royal Astronomical Society of Great Britain, and a Fellow of the American Association for the Advancement of Science. He had recently been notified of his appointment to serve a second term as a member of the Visiting Committee of the Department of Astronomy of Harvard University.

William Tyler Olcott was a gentleman of the old school—a man of gentle birth and breeding. Not strong of body, but strong of soul and purpose. A man to be respected and admired. A staunch and loyal friend. His life will long continue to be an example of steadfast adherence to principle.

Pudding Stone Inn, Boonton, New Jersey.

An Amateur's House-Top Observatory

By O. J. BLISS

In the spring of 1933, we decided to build a new home. An architect was engaged and a site selected, in a suburb of Chicago, which we considered suitable. The type of house was to be the so-called English Cottage. In the preliminary discussions with the architect, he was instructed to provide suitable space in the top for an observatory, if this could be done without detracting from the appearance of the house; in fact, it was preferred that there should be no evidence of the observatory from the outside, either front or rear. By a very clever arrangement of the roof members, this was accomplished.

The photographs show a front view of the house, a cross-section through the house on a north and south line, and a view of the instrument mounted for use.

The observatory is a room 12 feet by 12 feet, with the roof members of the house sloping in to form a flat deck 9 feet by 9 feet with an opening 5½ feet by 5½ feet. The roof panels are carried on angle-iron hangers which are mounted on ball-bearing carriers running on steel tracks.

Although the floor joists are 2 inches by 12 inches, there would be enough deflection from a person's walking on the floor so that even a small instrument mounted on a pedestal would be unsatisfactory. However, the roof framing is very rigid and is carried directly by the 12-inch brick walls and concrete foundation of the building. Therefore,

FIGURE 1
FRONT VIEW OF THE HOUSE WHICH CONTAINS THE OBSERVATORY

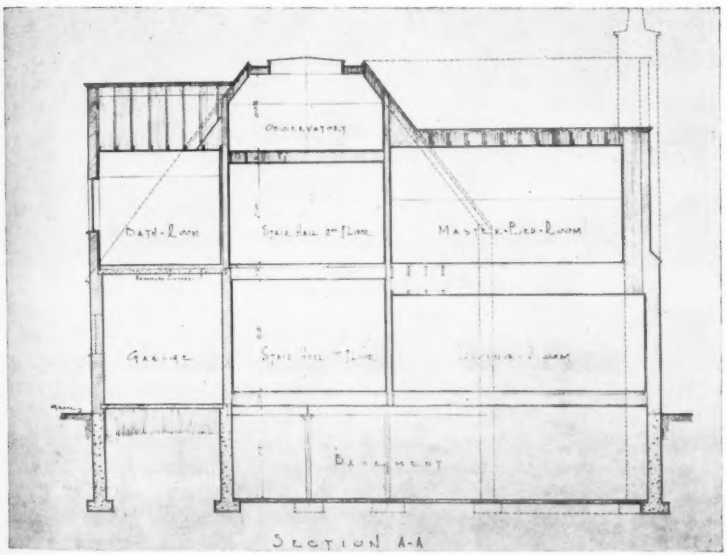

FIGURE 2
CROSS-SECTION OF HOUSE SHOWING SUPPORT OF TELESCOPE

a most unconventional type of telescope mounting was designed, taking advantage of the well-braced roof structure.

The mounting consists of two 5-inch steel channels, back to back with 3½ inches separation, and with top and bottom plates. The polar axis bearing is bolted between these channels. The ends of the channel beams are bolted into U-shaped hangers fastened to the north and south members of the roof opening. The bolts carrying the beam in the south U-hanger are horizontal, permitting a small final adjustment in azimuth. The bolts carrying the north end of the beam are vertical permitting a small final adjustment in altitude.

FIGURE 3
MR. BLISS AND HIS TELESCOPE

The telescope is an 8-inch combination Cassegrainian-Newtonian. For observing it will be used as a Cassegrainian; for other purposes it can be used as a Newtonian. The mirrors are pyrex, aluminum coated. The focal length of primary mirror is 48 inches or F/6 used as a Newtonian, F/24 as a Cassegrainian.

The German type of mounting for the tube was used because it was considered more suitable for this particular installation. When used as a Cassegrainian for observing, with a zenith prism, it is very convenient and permits of an easy, restful, position for the observer with all controls within reach.

The German type of mounting with the centers of rotation high permits observation of all parts of the sky to within about 15 degrees of the horizon. This is so because as the polar axis is rotated to the east or the west the declination axis comes up into a nearly vertical position with the tube pointing nearly horizontally over the roof opening.

With the roof panels open, the observatory is open to the sky, but the observer is sheltered and protected from stray light. To close the roof opening both declination axis and the tube are rotated to a horizontal position.

The instrument is provided with synchronous motor drive with proper gear reduction, with clamps and slow motion in right ascension and declination and with setting circles divided to 1 degree in declination and 10 minutes in right ascension. The setting circles can be read to about 1/10 these values.

Permanent wiring has been installed for the driving motor with pendant switch control. The photographs do not show the finder, but both finder and brackets are now ready for mounting. It is probably needless to say that accessories, for various purposes, will be designed and constructed. Amateurs are like that.

FEBRUARY 19, 1936.

The Schmidt Camera

By CHARLES H. SMILEY

In a paper published in 1932, Bernhard Schmidt[1] of the Hamburg-Bergedorf Observatory in Germany gave a brief account of a photographic telescope which he had constructed and which possessed a number of unusual features. It is the purpose of this article to describe the instrument and to present an elementary mathematical discussion of the theory underlying it. The two great advantages of this new camera are its unusually large useful field and the extremely rapid focal ratios in which it can be constructed. That the camera is not without faults will be seen in the following description of it.

At the center of curvature of a spherical mirror is placed a thin lens designed to eliminate the spherical aberration which would be present if the mirror were used alone. Schmidt pointed out that such a system could be constructed with a large relative aperture and yet have a large useful field free from coma and astigmatism. Chromatic aberration could not be eliminated entirely but could be minimized by a proper choice of shape for the thin lens. Unfortunately the focal surface of best definition was found to be a spherical surface of radius equal to the focal length of the combination, necessitating the use of curved photographic plates or films. The plate- or film-holder was placed approxi-

mately midway between the mirror and the lens, facing the mirror. A schematic diagram of a Schmidt camera is shown in Figure 1.

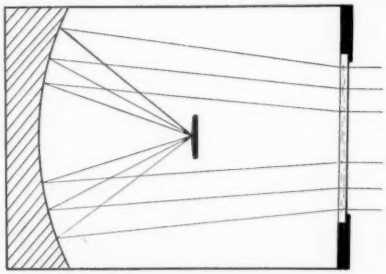

FIGURE 1

Schmidt did not publish a design for the thin lens; this was first provided by B. Strömgren[2] and later by F. B. Wright.[3] That Schmidt actually did design such a lens is shown in his construction of the first camera of this sort. The effective aperture of this instrument (i.e., the diameter of the thin lens) was 14.2 inches; its focal ratio was f/1.75. Its focal length was 24.6 inches and the diameter of the mirror used was 17.3 inches. Recently a number of Schmidt cameras have been completed in the United States. Dr. Theodore Dunham, Jr.,[4] of the Mt. Wilson Observatory tells of one, f/1.8 of five inches focal length and of another of focal ratio, f/1. Dr. H. P. Bailey of Riverside, California, has made one of 19 inches focal length and of focal ratio f/2.4. Mr. H. A. Lower of San Diego, California, has completed an f/1 of 8 inches focal length and has taken some splendid photographs with it, each covering a field more than twenty degrees in diameter. Figure 2 is a reproduction of one of these showing the region about Castor and Pollux.

An f/2 of four inches focal length has been made for Yerkes Observatory by G. Nicholson under the direction of Dr. A. H. Carpenter of Armour Institute of Technology and they are now making an f/1 of the same focal length. California Institute of Technology is building an f/2 of 36 inches focal length to be mounted on Palomar Mountain. An f/1 of four inches focal length is being made for Ladd Observatory of Brown University by H. A. MacKnight and D. S. Reed.

It seems likely that there will be several dozens of Schmidt cameras in use in this country by 1938. In Europe there seem to be very few, if any, under construction. A letter from Dr. W. H. Steavenson of London mentions that J. H. Hindle is constructing one of focal ratio f/2.

Before discussing the mathematics of the design of the thin lens, it will be well to make a few general remarks. Clearly the lens should be made of a material of low dispersion, such as hard crown glass, to minimize the effects of chromatic aberration. Also it should be kept thin to avoid needless absorption of light. If the camera is to cover a wide field, the mirror should be considerably larger than the lens to avoid

poor illumination at the edge of the field. Strömgren[2] has shown that the diameter of the mirror should be greater than the diameter of the lens by an amount equal to twice the diameter of the plate or film to be used. He also emphasized the important fact that the silhouetting due to the film-holder grows less objectionable as the ratio of aperture to focal length increases and hence wider fields can be covered by faster cameras. It is clear that there is a limit to the focal ratios which are possible with this type of camera. This limit is reached when the rays passing through the outer portion of the lens are upon reflection almost tangent to the film-holder. A camera of focal ratio about f/0.6 would be very near this limit.

FIGURE 2

It may be well to point out a few of the difficulties to be encountered by the maker of a Schmidt camera. The lens yielding a minimum amount of chromatic aberration is one which is weakly convergent in the center and weakly divergent toward the edge. If one face of the lens is plane, the central portion of the other side will be convex and the outer portion concave! Then too, the mirrror used will, for a fast camera, have a strong curvature, requiring the removal of a considerable amount of glass in its construction unless expensive specially pressed blanks are used. The precise testing of the nearly complete camera is difficult, particularly for very fast cameras. Finally there is the difficul-

ty of providing plates or films of the proper curvature. These difficulties are not insuperable and the complete instrument is distinctly worth the extra trouble. No other camera offers such a combination of wide field and high speed.

In the mathematical discussion following, certain assumptions are made to simplify the mathematics. For instance, it will be assumed that the side of the lens toward the incident light is plane. Then all of the curvature can be thought of as concentrated on the other side of the lens and, for rays parallel to the axis, the thickness of the lens may be neglected without error. We shall think of the focal point of the rays parallel to the axis as a point-source of light; we shall trace the rays of light from this point as they are reflected from the spherical mirror and proceed to the thin lens. We shall determine the curvature of each zone of this lens needed to render the incident rays parallel to the axis. These rays will then strike the plane surface normally and will not be deviated by that surface.

In Figure 3, F is the focus for rays originally parallel to the axis and is now to be considered as a point-source of light. Q is the center of curvature of the spherical mirror, the radius of which, OQ, is taken as 2. The distance, FQ, is denoted by k. P is the point at which a ray issuing from F and reflected by the spherical mirror at O meets the plane through the point Q perpendicular to the axis FQ. The distance,

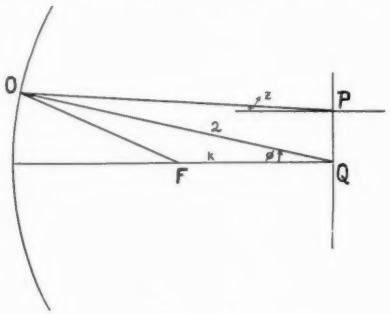

FIGURE 3

PQ, is taken as an independent variable, x; we shall need to consider only positive values of x. z is the angle which the reflected ray OP makes with the normal to the plane at P; it is to be considered as negative when a ray starting at F approaches the axis after reflection. The angle FQO is denoted by ϕ.

In the triangle POQ, $\angle OQP = 90° - \phi$; $\angle QPO = 90° - z$,

and hence $\angle POQ = \phi + z$.

But by the laws of reflection,

$$\angle FOQ = \angle POQ = \phi + z,$$

and $$\angle QFO = 180° - 2\phi - z.$$

Applying the law of sines to the triangle POQ, we have:

$$2/\sin(90° - z) = x/\sin(\phi + z)$$

and applying it to the triangle QOF,

$$k/\sin(\phi + z) = 2/\sin(2\phi + z)$$

Therefore,

$$k \sin(2\phi + z) = 2 \sin(\phi + z) = x \cos z. \qquad (I)$$

Starting with the particular value of x, x_0, for which z is to be zero, we have,

$$2 \sin \phi_0 = x_0 \; ; \; k = 2 \sin \phi_0 / \sin 2\phi_0 = \sec \phi_0 .$$

We shall describe the method of choosing x_0 later.

If we call $(\phi + z)$, v, and $(2\phi + z)$, u, equations (I) become

$$\sin u = (x \cos z)/k; \; \sin v = (x \cos z)/2; \; z = 2v - u.$$

It is clear then that with a chosen value of x and an estimated value of z, z_1, one may compute in turn, $(x \cos z)$, sin u, sin v, u, v, and z_2. Then one may use this new value of z with the same value of x, and upon repeating the sequence of operations just indicated, obtain another value of z, z_3. This may be continued until the initial and final value of z for a given trial are the same. The matter of convergence need not be discussed here; it will suffice to say that only a few trials are needed to obtain the final value of z if the first value assumed is not far from the truth. It is suggested that z be computed in this fashion for $x = 0, .05, .10$, etc., and that the intermediate values be obtained by interpolation.

We shall next determine the axial cross-section of the curved surface of the thin lens. In Figure 4, AP is the normal to the plane, AQ; BP is the incident ray, and CP is the normal to the surface which is to render the refracted ray, PD, parallel to the axis of the camera. Let x be the perpendicular distance of a point, P, on the surface of the thin lens from the axis, and let y be the distance of this point P from some arbitrarily chosen fixed plane parallel to the plane AQ. y is to be considered as positive when it is measured to the right of the reference plane. (The plane surface of the lens is to the right of the curved surface shown in Figure 4.) The angle APB is identified as z and the angle CPA is to be called w. If a point moving from C to P approaches the axis of the camera, w is positive.

By Snell's law of refraction, we have

$$\sin(w + z) = n \sin w$$

where n is the index of refraction of the material used for the thin lens. Expanding and dividing by cos w, we have:

$$n \tan w = \sin z + \cos z \tan w.$$

But $\tan w = dy/dx.$

Hence $$dy/dx = \sin z/(n - \cos z) \qquad (II)$$

Having chosen a glass of known index of refracton, n, the value of the derivative may then be computed for each value of x for which the value of z has been calculated. The values of y corresponding to these values of x are easily obtained by numerical integration by the use of

one of the well-known formulas to be found in any text on interpolation. The person who seldom has occasion to use such formulas will find National Research Council Bulletin No. 92 a very valuable reference. The formulas referred to above will be found on page 28 of this Bulletin.

In this integration we have at our disposal one constant of integration which determines the position of the plane with respect to which y is measured. It is convenient then to choose $y = 0$ for $x = 0$.

There remains only to explain how x_0 is to be chosen. This amounts to choosing the zone in which rays are not to be deviated by the lens. If one chooses $x_0 = 0$, the surface of the thin lens under consideration is concave throughout and rises very sharply toward the edge. However,

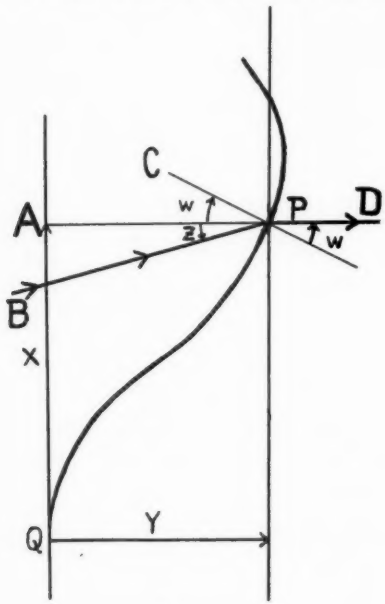

FIGURE 4

if one wishes to minimize chromatic aberration, one may choose x_0 so that the outward deviation of paraxial rays striking the edge of the lens in the completed camera is just equal to the maximum inward deviation of similar rays striking elsewhere on the lens. This value of x_0 depends only on the focal ratio of the camera and not at all on the glass chosen for the lens. For the focal ratio, f/1, $x_0 = 0.438335$ and the chromatic aberration resulting from the use of this value of x_0 is only 23.35% of that which results from using $x_0 = 0$. Third order equations give $x_0 = 0.433$ as an approximate value, regardless of the particular focal

ratio chosen. It should be mentioned that there are other definitions of "minimum chromatic aberration" than the one used here. Corresponding to each, there will be a particular x_0 for a given glass and focal ratio.

The equations presented here are designed to provide the best definition possible at the center of the field. It is a great advantage of the Schmidt camera that when the thin lens has been constructed to give good definition at the center of the field, the definition is good over a wide region. A partial verification of this fact may be obtained from third order expressions for the Seidel aberrations or a complete verification may be had from the construction and use of a camera.

It is suggested that one complete first the spherical mirror and then design the correcting plate to be used with it. In the table given below are the values of z and y for a lens for an f/1 Schmidt cfiamera, the lens to be constructed of glass of index of refraction, $n = 1.5$. In designing a lens, one would multiply both x and y by one-half the radius of curvature of the spherical mirror; that is, for a lens to be used with a spherical mirror of radius of curvature 20 inches, the figures given below for x and y would be multiplied by 10.

x	z	y
0.00	0.0000	0.00000
0.05	0.0688	0.00006
0.10	0.1328	0.00024
0.15	0.1868	0.00052
0.20	0.2256	0.00088
0.25	0.2434	0.00129
0.30	0.2338	0.00171
0.35	0.1896	0.00209
0.40	0.1023	0.00235
0.45	—0.0381	0.00242
0.50	—0.2349	0.00218

REFERENCES:

(1) Mitteilungen Hamburger Sternwarte in Bergedorf, v. 7, No. 36, 1932.
(2) Vierteljahrsschrift, v. 70, p. 65-86, 1935.
(3) Publ. Astron. Soc. Pac., v. 47, p. 300-304, 1935.
(4) Publ. Am. Astron. Soc., v. 8, p. 110-111, 1935.

BROWN UNIVERSITY, PROVIDENCE, R. I., MAY 10, 1936.

The Astronomical Fraternity of the World

By DAVID B. PICKERING

PART XVI

On the morning of August 6, 1931, Mrs. Pickering and I boarded the steamer *Hikawa Maru* at Yokohama bound for Vancouver. We took the northern route over a little-sailed course which skirts the Aleutian Islands. During the thirteen-day trip we had the first cabin companionship of only four other white people, two of whom, the Reverend John McKim, the veteran Episcopal Bishop of Tokyo, and the young and delightful Mrs. Charles Cummings, niece of Mr. Forbes, our Minister to Japan at that time, became our constant companions. There were friends to be made among the orientals as well, however. There was Mrs. Shinowara, for instance, who was returning to her home in Seattle after a visit with her relatives in Japan. Though she and her husband had lived in the States for twenty years, the customs of her native land still so impressed her that it was impossible to induce her to precede me through a doorway. She seemed to enjoy inducting Mrs. Pickering into the mysteries of Japanese feminine attire and showed her the trick of rolling one's self into an obi and tying it. Then there was Mrs. Kobayashi whose husband was a member of the New York Cotton Exchange, and whose cute little daughters were exactly like the black-eyed dolls you see in the bazaars. And there was handsome, young Yamakawa of the Diplomatic Service who was taking his new bride to his post in South America. Quite likely they had not met before the wedding, which just preceded the sailing date. In her new, silk finery she was as pretty and demure as a bisque doll. We last saw them as we were leaving the boat at Vancouver. He was stalking along the dock, while she, carrying the hand-bags, was followed yards behind. I suggested this Japanese mode of debarkation to Mrs. Pickering but she seemed not to be interested.

Our day in Vancouver was a busy one, but the customs officers, so unlike our own, were kind to us and passed our trunkful of trinkets without disturbing them, allowing them to remain with other heavy baggage at the Vancouver station while we were away visiting the Dominion Observatory at Victoria. I had phoned the observatory early in the day and had been surprised to hear Dr. Harry Plaskett's voice coming over the wire. He assured me that Victoria would give us a warm welcome. Dr. Plaskett is now the Director of the Oxford University Observatory, having been appointed to succeed the late Professor H. H. Turner, but at the time of which I write he was a member of the staff of the Harvard College Observatory and had brought his family to Victoria for the summer to visit his parents and to carry on some important research work with the 72-inch mirror. We had known Dr. Plaskett

long and well through our meetings in Cambridge. He was young and handsome with an appealing personality, a wealth of kindliness, and possessed of a balanced and alert mind. He was one of those calm, quiet chaps who seem to have become masters of themselves and their jobs and who unwittingly make the average awkward individual appear more awkward. Dr. Harlow Shapley referred to Harry Plaskett as "My Understudy" and would often call upon him as a substitute lecturer when the Harvard Director found himself unable to keep an engagement, for the younger man had a flair for correct expression, a knack of imparting information, and a splendid speaking voice.

FIGURE 1
ADMINISTRATION BUILDING OF THE DOMINION ASTROPHYSICAL OBSERVATORY, VICTORIA, B. C.

After an all-night sail we arrived at the city of sunshine and flowers at seven in the morning and went to the Empress Hotel. At nine came Dr. Plaskett with his family to give us the keys to the city. Mrs. Plaskett was tall and smiling and had all of Harry's quiet poise and charm. Barbara was nine, round and dimpled and yellow-curled, and John, who was four, was an inexhaustible engine of fun and mischief. We bundled into their car and they drove us westward from the town,

dropping Harry at the observatory three miles away and then going on for five more to the Buchard estate, whose gorgeous gardens are one of the show places of Victoria. I took a picture of Barbara standing beside a dahlia as big and yellow as her own curly head.

Later in the morning we returned to the Administration Building of the observatory and there met Professor J. S. Plaskett. We had last seen Professor Plaskett at the Holland meeting of the International Astronomical Union in 1928, at which time he was hobbling about on crutches. It was hard to believe that the strong, hearty man who now

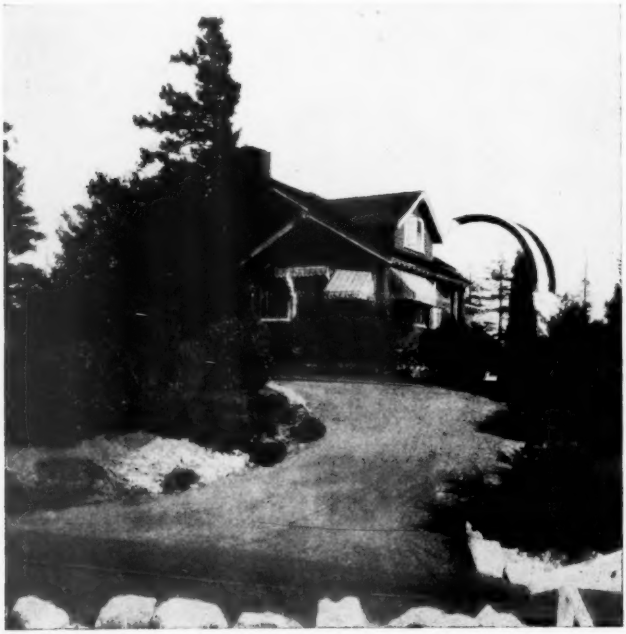

FIGURE 2
RESIDENCE OF THE DIRECTOR OF THE OBSERVATORY.

greeted us could be the same person. He is a broad-shouldered, loosely built man, with pronounced features, thinning gray hair, and close cropped gray mustache. We visited in the library for a half hour or so where Professor Plaskett was interested in learning of our visit to the Japanese astronomers, and then he drove us to his home. The sides of the winding road were guarded by white-washed stones and as we drove up the private way to the flower-bordered porch of the Director's residence, the white dome of the world's second largest telescope could be seen above the low trees only a couple of hundred yards away. Here

Mrs. Plaskett was waiting to greet us. She was a dear motherly woman, beaming kindliness. Her voice had the fascinating English accent which some others among our Canadian friends have in greater or less degree.

A good home-cooked dinner was waiting for us. A roast of lamb with carrots, peas, potatoes, *and* cherry pie and blackberries. How we relished it! After every mouthful there was a sigh of satisfaction from those who had been so long in the land of rice, fish, and chop-sticks. Coffee was served in the living room, where were hung examples of

FIGURE 3
PROFESSOR J. S. PLASKETT, DIRECTOR OF THE OBSERVATORY.

Professor Plaskett's photography. Among these were splendid pictures of snow and tree scenes, evidences of the Director's enthusiasm for camera work, which, as he told us, antedated his astronomical activities. It was through his study of the optics of photography that he became interested in the instruments of astronomy. He told us how the Victoria Observatory came into being. It was during Professor Plaskett's administration of the Ottawa Observatory that he became convinced that Canada should have a great telescope, located on a site better suited to its power than those of any of the existing stations. After a

year of effort his assurance and enthusiasm sold the idea to the Canadian Government. The disc was ordered from the St. Gobain Co., of Belgium, and by great good fortune was shipped by them to Dr. John Brashear in Pittsburgh, only a couple of weeks before the outbreak of the great war. Any slight delay would have tied up the enterprise indefinitely. The 10-inch hole in the center of the disc was pierced by the St. Gobain people while the casting was still soft, and this made the grinding and polishing extremely difficult. It is the only mirror of major proportion, I believe, so constructed. The grace and stability of

FIGURE 4
MRS. HARRY PLASKETT, MRS. PICKERING, MRS. J. S. PLASKETT, PROFESSOR J. S. PLASKETT.

the two-pier type mounting by Warner and Swasey, and the excellence of the innumerable refinements that entered into the construction of the mechanical parts and motive equipment, were the result of the closest cooperation between the Cleveland firm and Professor Plaskett. The latter's ambition to have an instrument that would approach perfection in facility of operation resulted in a period of interesting if strenuous planning and achievement, which Professor Plaskett declares to have been at all times most congenial. He never tires of extolling the recep-

tive and kindly spirit of the builders in considering his many radical suggestions.

It was mid-afternoon when Professor Plaskett took me to see the observatory. A short walk along evergreen-bordered ways brought us to the dignified building which rests upon one of the rolling hills and seems a more reposeful giant than the monster on Mt. Wilson. The Dominion Observatory at Victoria is a single-instrument institution, and, under the established order of things, that instrument is to be made the most of. Guests are welcomed at all times during the day and on Saturday nights are privileged to look through the telescope.

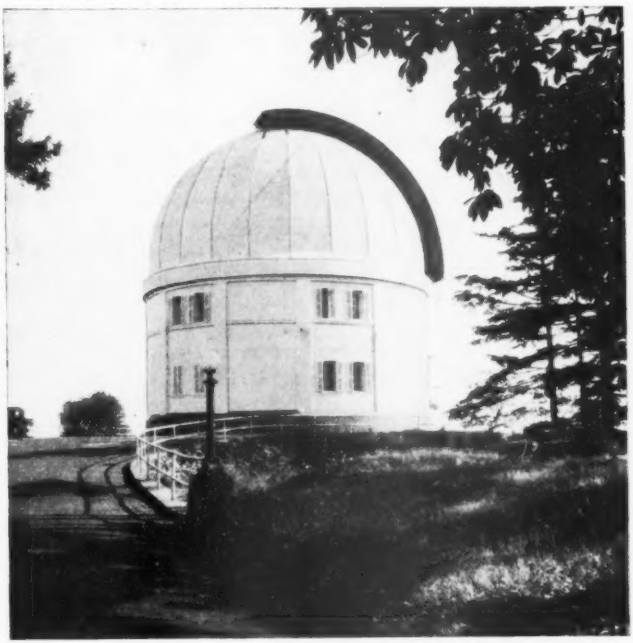

FIGURE 5
THE DOMINION ASTROPHYSICAL OBSERVATORY, VICTORIA, B. C.

There was an unusual amount of daylight under the dome and we were impressed by the orderliness and cleanliness of everything. The slit was open and the telescope was directed toward the sun. Dr. Harry Plaskett was making spectroscopic observations of the solar surface to determine relative temperatures of grain and faculae. This was part of the research which he later used in publishing several important papers on the subject. A guide was talking to a number of spectators who were grouped on the opposite side of the room.

The southern end of the cylindrical polar axis of the mounting rested on a low base, while the northern end was elevated and attached to a high, reinforced concrete pier. The "tube" and its massive counterweight were attached to the declination axis on either side of the polar axis. Since this construction admits of bringing the tube parallel to the polar axis, it can be directed to or below the north star, an advantage lacking in many of the mountings of other large telescopes. The controls make it possible to increase the speed of movement of the tube in either direction to 20 times that of "slow motion." The adjustments had been so nicely made that the tube could be easily swung by applying the pressure of a couple of fingers. Circle settings can be read to minutes of arc, another evidence of very careful adjustment. A spring curtain covered the end of the tube to minimize the direct rays of the sun while the plate-holders were being handled.

The mirror was silvered twice a year, before the recent process of aluminum coating came into use. The dome is lined with sheet metal and is of the usual double construction.

It was while Professor Plaskett was explaining these things to me that a gentleman from the group of sightseers approached us and, inquiring for the Director, introduced himself as Simon Newcomb. To say that we were startled is to put it mildly. I was on the point of asking if the bearded gentleman in his party was Galileo, but his calmness was reassuring and he explained at once that he was a nephew of *the* Simon Newcomb. He told us that as a young man he had consulted his uncle as to the wisdom of adopting astronomy as a vocation and that the latter had advised him not to do so. Mr. Newcomb was at that time manager of the Sir Frances Drake Hotel in San Francisco.

From the observatory we walked to the Administration Building where Harry Plaskett met us and drove us to our hotel. Later in the afternoon he returned with his family and Dr. Frank Hogg and Mrs. Hogg to take us out to dinner.

Frank and Helen Hogg had been old friends of ours. Both had been on the staff of the Harvard Observatory where, before her marriage, Mrs. Hogg had been Helen Sawyer, Curator of Charts for the American Association of Variable Star Observers, a job she still held. As I had been Chairman of the Chart Committee, she and I had worked together for years and became great pals. Helen was gifted with enthusiasm, humor, and common sense. She was accurate and systematic in her work. Her efficiency and promptness in stocking and distributing the required thousands of blue-print charts and her careful method of keeping the records, all of which was undertaken as a labor of love, was of major importance in maintaining efficiency in the work of the A.A.V.S.O. When Dr. W. H. Steavenson, Mr. Yalden, and I visited the Harvard Observatory in the spring of 1930, Helen was working for her Ph.D. and Frank Hogg was never very far away. There was romance in the air. They were married, I think, before the end of that

year, and as Frank was Canadian born it was not unnatural that they should have accepted the chance to join the staff of the Dominion Observatory soon afterward. It was at about this time that Helen became interested in collecting stamps. She specialized in memorial issues and for a long while thereafter my services were in demand for specified blocks of stamps, some of which I was commanded to stick carefully on every package of charts that was sent to the Curator for distribution.

Later on we learned of the arrival of Sally Hogg, and hardly a letter came that did not contain at least one picture of that wonderful baby. The Hoggs moved from Victoria to Toronto to join the staff of the Dunlap Observatory when that institution began to function. Last winter, in Florida, we received a card announcing the birth of David Edward. The grandfather for whom I was named was christened David Edward, but stranger still, young David was born on my birthday, January 18.

That night in Victoria was a merry one. We were driven to some little French restaurant twenty-five miles from town, on the shore of an inlet of the Sound, a place famous for its food and for the glorious views to be had from its wide verandas. What a good time we had and what a strenuous game I played with young John all the way home! He assumed the role of a young bear and made believe that I was a tree over which he must climb continuously. Before returning to the hotel we stopped at the Hogg apartment where Helen showed us the volumes prepared for her stamp collection. Each page of the big scrap-books was carefully designed by her to accommodate the blocks of various sizes still to be acquired. She *would* plan it all just that way.

Still later that night Dr. Harry Plaskett drove me to the observatory to have a look through the big telescope. There we found Mr. Petrie of Ann Arbor, a member of the staff who was much interested in variables, and Mr. Hutchinson, the mechanic. They were ready to direct the glass toward any section of the sky I desired to see, and as I had a mind to look at the little triangle containing our old friend SS Cygni, I asked them to set on 213843. The slit was open and with the pushing of a button or two the great machine quietly swung into the desired position. With pleasurable anticipation I placed my eye at the ocular—and saw only a single star. There was no great thrill in that and we proceeded to sweep slowly about the field. Each time the telescope came to rest, there again was a solitary, lonesome star. It was impossible to tell *which* star or to what asterism it belonged. Much perplexed I finally thought to inquire as to the area of the field visible in the eyepiece and was told that its diameter was 60 seconds of arc. Small wonder that we couldn't find the triangle. It was like trying to identify a friend by seeing only one pore of his skin. The sky was teeming with brilliancy when we at last stepped out into the night. I exclaimed at the distinctness of the Andromeda Nebula, which was then nearly overhead, and felt very important when Dr. Plaskett asked me to show it to him.

We were to take boat to Vancouver at noon next day, and before sailing drove to the Marine Chalet Apartments to see Frank and Helen and bid them good-bye. Helen was beaming as usual and vibrating between her household duties and the huge files of variable star charts which she so efficiently managed. They came down to our waiting taxi, and as we had made our adieus to the Plasketts the night before, they were the last we saw of those who had made a merry holiday for us on this observational pilgrimage.

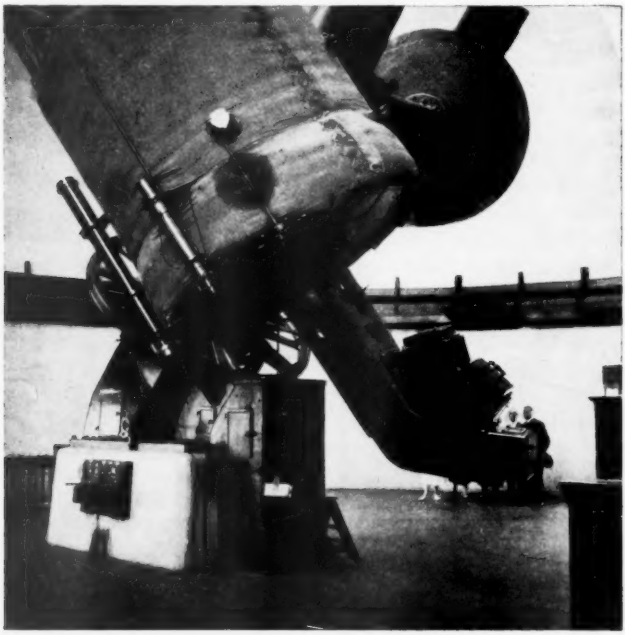

FIGURE 6
SEVENTY-TWO-INCH MIRROR OF THE DOMINION ASTROPHYSICAL OBSERVATORY.

Next day found us speeding through the Canadian Rockies on our impatient journey toward the home and family we had left seven months earlier.

We returned home loaded with souvenirs and pictures and rich in experience, but richest of all in the friendships we had made or renewed among those people whose hearts and minds are so much with the stars.

PUDDING STONE INN, BOONTOWN, NEW JERSEY, AUGUST 1, 1936.

Eclipse Hunting in the Hokkaido*

By JOSEF J. JOHNSON[1]

In 1934 I had the privilege of accompanying the Japanese Eclipse Expedition to Losap Island, in the eastern Carolines. On the cruiser "Kasuga," provided for the trip by the Imperial Japanese Navy, we were entertained by daily exhibitions of "Sumo" and "Judo," forms of Japanese wrestling. On the island we all enjoyed the exciting sport of dodging the falling cocoanuts. So delightful were my recollections of all this that I looked forward in pleasant anticipation to my next trip to Japan, this present one of 1936, to observe the total eclipse of the sun of June 19 from Hokkaido, the northern island.

But there were some misgivings, particularly with regard to the language difficulty sure to be encountered by a foreigner traveling in a part of the Empire far away from the beaten track of the tourists. So it was with much relief that I received a radiogram from the National Research Council of Japan saying that their representative, Mr. T. Sakurai, would meet my ship at Yokohama and accompany me all the way to the eclipse camp. I discovered, also with relief, that a new hotel had just been completed at Abashiri, on the north coast of the island, and was prepared to serve bacon and eggs and beefsteak in the good old American manner, thus obviating the necessity of brushing up on my chop-stick technique.

Dr. Kiyofusa Sotome, director emeritus of the Tokyo Observatory, had established an observing station at Memambetsu, a few miles inland from Abashiri, and very kindly invited me to make use of the facilities of his camp for my own observations. Dr. Sotome was in charge of the 1934 expedition and had visited me in Pasadena in the fall of 1935; it was a pleasure to be again with an old friend.

I had arrived at the camp only two days before the eclipse, but as my apparatus was light and easily set up, I still had plenty of time to look around. After making sure that everything was all right, I was driven a few miles out into the country to inspect the camp of the Tokyo Meteorological Observatory, under Dr. R. Sekiguchi. The meteorologists were interested primarily in measuring the changes in the earth's magnetic field during the eclipse, a program which has the immense advantage of being independent of weather conditions. But here also were a number of astronomers, including my friend, Mr. Yoshio Fujita, who had made the trip to Losap. Mr. Fujita planned, as in 1934, to photograph the spectrum of the corona. And here, again, was a very strange sight indeed, a working model of an eclipse. Now artificial

*Short-wave broadcast from JOAK, Tokyo, July 1, 1936.

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eclipses are not unknown—a number of them are on view in American museums—but here, for the first time to my knowledge, was such a contraption made for the serious purpose of training eclipse observers. A black disc representing the moon was made to pass slowly in front of a white one, the sun, and, at "totality," a faint glow of light appeared—a synthetic corona. The discs, about two feet in diameter, were placed at such a distance from the observers as to have the same apparent size as the heavenly bodies they represented.

FIGURE 1.
TELESCOPE FOR EINSTEIN EFFECT, TOKYO OBSERVATORY.

Eclipse day greeted us, as was expected, with a partly cloudy sky. All depended upon last-minute luck; would a cloud or a clear area be in the crucial position at the time of totality? The Japanese astronomers had guarded against this situation by distributing themselves in a large number of small parties, scattered all along the north coast of Hokkaido. Only two were at Memambetsu, Dr. Sotome and Mr. Gemma Yoshida. Fortunately for me, a guest at their station, luck favored these two. A very thin wisp of cloud did pass by during totality, but it was scarcely noticeable and did not hamper the observations; for the most part, we were observing the eclipse in an area of clear blue sky.

Dr. Sotome's program, as in 1934, consisted in photographing the eclipse against the background of stars in the hope of detecting that slight displacement of star-images which has such an important bearing on the theory of relativity. It will be some time before his results can be known. Mr. Yoshida secured some excellent photographs of the outer corona.

My own work consisted in the measurement of polarization; the determination of the percentage of polarized light in the total amount of

light received from the corona. This is a relatively simple job, as eclipse observations go, requiring only a small, portable telescope with polariscope attached. Thus I was enabled to arrive at the scene of operations only a couple of days before the eclipse, whereas most of the observers had to spend many weeks in the construction and testing of elaborate apparatus.

It would be unprofitable, in a rambling report like this, to inquire into the question: "what is polarized light?" Polarization is a peculiar quality or property which is understandable only in terms of rather complicated physical and mathematical concepts. But its bearing upon eclipse measurements is quite readily understood: polarization is a measure of scattering. Scattered light is polarized; light which comes to the observer directly from a source, be it the sun, or a flame, or an incandescent filament, is unpolarized.

A familiar illustration of scattering is provided by the earth's atmosphere. You have all noticed that the sky is blue, and that the sun becomes reddish in color when it is low in the sky and therefore seen through a great thickness of air. These observed colors simply mean that the blue light has been scattered much more than the red. Now the laws of scattering depend upon the nature of the scattering medium. The corona is obviously quite different from the earth's atmosphere, for its color is white, not blue. We must be careful about drawing conclusions from the color alone, because we cannot tell by looking at the corona whether all its light is scattered sunlight or whether a part may come from luminous matter in the corona itself. As a matter of fact, we know from spectroscopic observations that the latter is the case.

But the polarization measurements give us, independently of this complication, a direct measure of the scattering, and enable us to determine the relative amounts of scattering for light of different wavelengths. As a result of my observations at Losap in 1934, which were confirmed at this recent eclipse, I can say with a fair amount of assurance that the light of the corona is due in very large part to the scattering of sunlight by free electrons. In other words the corona is ionized, or electrified, to an extent which has no parallel here on the earth.

Do I hear someone ask: "what of it?" "Suppose it is. What good does it do us to know that? What possible practical application can such information have? In fact, what good is astronomy anyway?" Such questions are very embarrassing. It is useless to point to the well-known applications of astronomy to problems of navigation, surveying, the measurement of time, etc. These things, important as they are, pertain to but a very small portion of the field of astronomical research. Until a few days ago, I should have answered such questions with high-sounding phrases about the glories of the heavens and the cultural values of astronomy. But now I am disillusioned. There recently appeared in the Tokyo papers, reprinted from the *New York Times*, a little article which spoiled everything. It seems that Dr. Harlow Shap-

ley, director of Harvard College Observatory, recently delivered a lecture in which he said that the greatest contributors to astronomy have been Andrew Carnegie and John D. Rockefeller. They gave large sums of money, with obviously no expectation of financial return. Whereupon someone rose to remark that the Rockefeller interests want people to rivet their gaze on the nebula in Andromeda so that they won't notice

FIGURE 2.
FOUR-INCH REFRACTOR WITH POLARISCOPE ATTACHED, FROM CALIFORNIA INSTITUTE OF TECHNOLOGY; DR. JOSEF J. JOHNSON.

the price of gasoline in the United States. Wealthy men are subsidizing astronomy to divert the people's attention from economic, social, and political affairs. The idea is that capitalism invites people to look up at the stars and, while they are so engaged, picks their pockets.

This struck home. All the more so because my college, the California Institute of Technology, is now engaged in building a 200-inch tele-

scope, the largest in the world, entirely with funds from the Rockefeller Foundation. And as to my present trip, it seems that, instead of being an innocent eclipse hunter as I had thought, I am a vile conspirator, encouraged by our unscrupulous capitalists to grind down the proletariat.

Well, the day after the eclipse, I went over to Kamishari to visit my fellow-conspirators, the British party under the leadership of Dr. F. J. M. Stratton. Among them was my friend, Dr. A. D. Thackeray, whom I had seen just recently at the Mount Wilson Observatory in Pasadena. All seemed to be happy and cheerful despite their disappointment of the day before. They had spent weeks of careful preparation, assembling the most elaborate collection of apparatus I have ever seen at an eclipse camp, only to have most of their efforts come to naught because of a cloudy sky. Occasional breaks in the clouds allowed them to carry out successfully a few items of their varied program.

We knew in advance that there was only a forty-percent chance of a clear sky in the Hokkaido. We were prepared to take that chance, and of course I am duly grateful that luck favored Memambetsu. But also we knew in advance that there was a one-hundred-percent certainty of receiving the traditional Japanese hospitality; one-hundred-percent certainty that, clear skies or cloudy, Japanese of high and low station alike would do all in their power to make our stay a happy and a profitable one. So completely was this realized, that even had the Memambetsu skies been cloudy, I should consider my trip very much worth while.

Eclipse Reports from Japan

Mr. Y. Iba, an amateur astronomer of Kobe, has sent in a brief report and four photographs directly or indirectly related to the eclipse. Among the photographs is an excellent print of the flash spectrum secured at Wakkanai with an 8½-inch aluminized reflector. Other photographs show the instrument and a group of six English and Japanese astronomers. Mr. Iba states that an attempt to photograph the corona was unsuccessful but that a series of 150 exposures was made during the partial phase.

I am very glad to tell you about the total eclipse of the sun June 19, 1936, at Hokkaido, Japan. The greater part of the sky on the eclipse day was cloudy, but fortunately, at the time of totality, clouds retreated from the sun. Many expeditions of Japanese were successful. But I am extremely sorry to say that Cambridge (England) party was completely defeated by clouds.

I am an amateur living on the coast of Setonaikai, an inland sea of Japan. I went to Sawaky Kitamy, Hokkaido, to observe the phenomenon, taking a small camera with me. I took four plates during the total eclipse, the first and second are of the outer and inner corona (Ilford H. S. Panchro), the third (infra-red Agfa 855), and the fourth for corona photometry. The corona was very active and splendid. Five arms extended somewhat as a starfish, but prominences were very poor.

TSIACKY MORIYAS.

Kwanonzy-Tyo, Kagawa-Ken, Japan, July 1, 1936.

Planet Notes for November, 1936

By CLIFFORD E. SMITH

Note: All times, unless otherwise stated, are Central Standard Time.

The *Sun* will be moving with an apparent southeasterly motion from the western part of Libra to the northern part of Scorpio. Its distance from the earth will decrease from about 92.18 million miles to about 91.60 million miles. The position of the sun on the first and last days of the month will be, respectively: R.A. $14^h\ 24^m$, Decl. $-14°\ 18'$, and R.A. $16^h\ 23^m$, Decl. $-21°\ 35'$.

The phenomena of the *Moon* will occur as follows:

Last Quarter	Nov.	5 at	7 P.M.
New Moon		13 "	11 P.M.
First Quarter		21 "	7 P.M.
Full Moon		28 "	10 A.M.
Apogee		12 "	4 A.M.
Perigee		27 "	8 A.M.

Mercury will be moving with an apparent easterly motion from eastern Virgo, across Libra, to northern Scorpio and southern Ophiuchus. At the beginning of the month it will be a morning object rising about forty minutes before the sun. During the middle and latter part of the month, however, it will be within 5 or 6 degrees of the sun, and, therefore, will not be of special interest. The distance of Mercury from the earth on the first of the month will be about 120 million miles, and the corresponding apparent diameter will be about 5 seconds of arc. Its position on November 1 will be R.A. $13^h\ 45^m$, Decl. $-9°\ 10'$. Conjunction with the moon will occur on November 13, and superior conjunction with respect to the sun will occur on November 18 at 5:00 A.M.

Venus will be an evening object setting about two hours after the sun. Its apparent motion among the stars will be easterly from the southern part of Ophiuchus to the northern part of Sagittarius. Its distance from the earth will decrease from about 125 million miles to about 110 million miles, and the corresponding change in apparent diameter will be from about 12.5 to about 14.5 seconds of arc. A conjunction with Jupiter will occur on November 13 at 6:00 A.M. (Venus 1°.9 S), and a conjunction with the moon will occur on November 17 at 5:00 A.M. (Venus 2°.4 S).

Mars will be a morning star, and, during the middle of the month, it will rise about three and a half hours before the sun. Its distance from the earth will decrease from about 205 to about 180 million miles, and its apparent diameter will increase from about 4.3 to about 4.8 seconds of arc. The motion of Mars among the stars will be easterly from the southeastern part of Leo to the western part of Virgo. Conjunction with the moon will occur on November 9 at 2:00 P.M. (Mars 7°.2 N).

Jupiter will be an evening object in southern Ophiuchus. During the middle of the month it will set about two hours after the sun. Its distance from the earth will be about 560 million miles, and its apparent diameter will be about 30 seconds of arc. A conjunction with Venus will occur on November 13 at 6:00 A.M. (Jupiter 1°.9 N), and conjunction with the moon will occur on November 16 at 9:00 P.M. (Jupiter 4' S).

Saturn will be an evening object in eastern Aquarius. It will set soon after midnight. Its distance from the earth will be about 850 million miles and its apparent diameter will be about 16 seconds of arc. Its apparent motion will be retrograde until November 20. Saturn will be in conjunction with the moon on November 23 at 5:00 A.M. (Saturn 8°.0 S).

Uranus will be a night object in southwestern Aries, and it will be above the horizon most of the night hours. Its apparent motion among the stars will be retrograde. Its distance from the earth will be about 1750 million miles, and its apparent diameter will be about 3½ seconds of arc. Conjunction with the moon will occur on November 26 at 1:00 P.M. (Uranus 4°.5 S). The position of Uranus on the fifteenth of the month will be: R.A. $2^h\ 19^m$, Decl. +13° 24′.

Neptune will continue as a morning star in southwestern Leo near τ Leonis. Its apparent motion among the stars will be easterly, and, during the middle of the month, it will rise about four hours before the sun. The distance of Neptune from the earth will be about 2840 million miles and its apparent diameter will be about 2.4 seconds of arc. Conjunction with the moon will occur on November 8 at 8:00 P.M. (Neptune 6°.7 N). The position of Neptune on the fifteenth of the month will be R.A. $11^h\ 20^m$, Decl. +5° 27′.

OCCULTATION PREDICTIONS

(Taken from the *American Ephemeris.*)

OCCULTATIONS VISIBLE IN LONGITUDE +72° 30′, LATITUDE +42° 30′.

Date 1936		Star	Mag.	IMMERSION Greenwich C.T. h m	IMMERSION *a* m	IMMERSION *b* m	IMMERSION Angle E from N °	EMERSION Greenwich C.T. h m	EMERSION *a* m	EMERSION *b* m	EMERSION Angle E from N °
Nov.	1	192 B.Tau	6.2	0 35.7	+0.1	+1.6	64	1 29.7	−0.4	+1.2	269
	1	υ Tau	4.4	6 52.8	−1.8	−1.1	112	8 2.5	−1.8	+0.6	240
	1	72 Tau	5.4	7 22.8	−1.8	+0.1	78	8 37.2	−1.5	−1.1	277
	8	55 Leo	6.0	11 4.6	−1.2	−1.2	142	12 25.8	−2.0	−0.6	287
	24	19 Psc	5.3	1 51.0	..	..	124	2 23.7	..	..	175
	25	136 B.Psc	6.5	1 58.2	−1.7	+0.3	72	3 11.5	−1.3	+0.6	231
	26	27 Ari	6.4	21 33.7	−0.6	+0.7	117	22 10.5	+0.3	+2.5	200
	28	133 B.Tau	5.9	5 7.3	−1.6	+2.4	35	5 57.4	−1.5	−2.9	309
	28	τ Tau	4.3	22 50.0	+0.5	+2.0	43	23 32.4	−0.5	+0.6	297
	30	141 Tau	6.3	5 25.0	−1.8	−3.5	152	6 9.2	−2.1	+3.3	220
	30	14 B.Gem	6.0	9 20.6	−0.8	−1.8	120	10 23.0	−0.8	−1.2	268

OCCULTATIONS VISIBLE IN LONGITUDE +91° 0′, LATITUDE +40° 0′.

Nov.	1	192 B.Tau	6.2	0 38.3	+0.6	+1.6	50	1 22.7	−0.1	+0.8	285
	1	υ Tau	4.4	6 17.7	−2.0	−0.3	110	7 25.9	−1.7	+1.8	232
	1	72 Tau	5.4	6 47.5	−1.8	+0.8	80	8 6.3	−1.9	+0.1	265
	2	394 B.Tau	6.1	12 36.2	−2.3	+1.5	43	13 13.7	+0.1	−4.1	339
	2	175 H′ Tau	6.5	12 43.9	..	..	185	12 50.7	..	..	197
	8	55 Leo	6.0	10 56.8	..	..	181	11 37.6	..	..	241
	24	19 Psc	5.3	1 4.4	−2.3	+0.3	90	2 8.8	−0.9	+2.1	202
	25	136 B.Psc	6.5	1 26.4	−1.4	+1.6	51	2 41.9	−1.7	+0.8	245
	26	27 Ari	6.4	21 28.9	+0.2	+0.9	104	22 10.7	+0.4	+1.9	217
	28	133 B.Tau	5.9	4 33.6	−1.2	+3.0	33	5 28.6	−2.2	−1.7	301
	28	32 Tau	5.8	8 13.3	−1.8	+2.0	32	8 52.3	−0.5	−3.8	322
	28	*A* Tau	4.5	11 25.7	+0.3	−2.0	129	12 6.7	−0.2	−0.2	232
	28	39 Tau	6.0	11 47.9	+0.9	−3.2	152	12 12.7	−0.6	+1.0	209
	28	τ Tau	4.3	22 58.3	+1.0	+2.3	24	23 24.5	−0.3	−0.2	318
	30	141 Tau	6.3	4 56.4	..	..	159	5 25.5	..	..	204
	30	14 B.Gem	6.0	9 11.2	−0.8	−3.6	153	9 58.5	−2.2	+0.9	232

OCCULTATIONS VISIBLE IN LONGITUDE +120° 0′, LATITUDE +36° 0′.

Nov.	1	υ Tau	4.4	5	34.4	−0.8	+1.2	86	6	38.9	−0.9	+1.6	248
	1	72 Tau	5.4	6	5.3	−0.6	+2.0	60	7	10.7	−1.5	+0.7	274
	1	284 B.Tau	6.0	10	58.5	−2.1	+1.2	57	12	3.3	−1.4	−2.3	303
	1	τ Tau	4.3	13	53.9	−0.4	−2.2	129	14	45.2	−0.9	−0.2	240
	2	394 B.Tau	6.1	11	31.0	−2.2	+0.4	85	12	52.7	−2.0	−1.1	286
	4	g Gem	5.0	14	23.4	..	..	40	14	43.8	..	..	10
	24	19 Psc	5.3	0	14.4	−0.9	+1.9	54	1	25.3	−1.4	+1.5	242
	25	136 B.Psc	6.5	0	56.6	0.0	+2.9	12	1	42.3	−1.9	+0.3	288
	28	32 Tau	5.8	7	13.1	−1.8	+1.8	52	8	23.1	−2.1	−1.3	288
	30	141 Tau	6.3	4	13.9	−0.9	−0.2	131	4	57.9	−0.1	+2.6	224
	30	η Gem	3.3	10	58.8	−2.3	+0.7	64	11	56.9	−0.8	−3.0	324

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 miles of the point indicated. The procedure is as follows: Subtract the longitude of the point given from the longitude of the place in question; multiply the result, in degrees, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude, using *b;* apply the sum of the products, with its proper sign, to the Greenwich C.T., and obtain the predicted Greenwich Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to subtract five hours; Central Standard Time, six hours, etc.

METEORS AND METEORITES

Meteor Notes from the American Meteor Society

By CHARLES P. OLIVIER, President

For the first time in several years, the newspaper publicity for the Perseids failed. I was on vacation at the time, and the notice sent to the Associated Press did not reach the proper persons. Therefore there was no general appeal for observations and, as there was no advance request, the general public did not send in reports. Our own members, however, were unusually active in both July and August, and results of value were obtained. There has not yet been time to work up any of the radiants shown upon the numerous maps received with the reports, or to tabulate the rates. These will all be published later.

A few personal impressions can be given. My own work was confined to the nights of August 11-12 and 12-13, when I observed from "Shadwell," in Albemarle County, Virginia. The first night was mostly cloudy with moonlight interfering, but in a few very clear intervals the Perseids gave a fair indication of their activity. The next night was mostly clear, some intervals having F = 1.0, and the moon was too narrow a crescent to do much harm. My impression was that the shower was distinctly below average in richness. However, two very interesting meteors were seen: (1) on the first night a second-magnitude sporadic, which had a path of 60°+, duration 5 sec., train 2 sec., having disappeared low in the west, reappeared 5° farther on and went another 5°; (2) on August 12-13, a zero-magnitude Perseid left a train visible for ten seconds. Several of the brighter Perseids left trains that lasted from 1 to 3 seconds. I found a sharp decline in hourly rate before dawn on August 12-13, indicating that we were well out of the densest part of the stream.

Reports from some of our more distant sections have not yet been received; consequently we do not know whether simultaneous observations to determine

meteor heights were undertaken by them. Near here, F. W. Smith at Glenolden, Pennsylvania, F. F. Marsh at Frederick, Maryland, and J. L. Woods at Sykesville, Maryland, assisted by J. B. Field and P. S. Watson, observed coöperatively on August 12-13. A brief inspection of their records shows a number of probable coincidences. The Louisville Astronomical Society, Louisville, Kentucky, recorded some meteors also probably observed by L. J. Wilson at Nashville, Tennessee. Several of our observers tried to get meteor photographs, and a few good tracks were recorded on the plates. These will also be discussed later when they have been more fully examined and measured.

One of the most extensive reports we have received is from Eppe Loreta of Bologna, Italy. From July 25-26 through August 16-17, he observed both Delta Aquarids and Perseids on many nights, under good conditions. His tabular results will give a good picture of cross-sections of both streams. A very interesting account of his observations of meteor train drifts observed with a field glass is included in his report. One, for instance, visible only 10 seconds to the naked eye, remained 100 seconds in the glass and showed both drift and change of form. The meteor itself was of magnitude —4. Another meteor for which he recorded a long-enduring train was also recorded elsewhere, and we can probably compute both the actual height of the train and the linear velocity of the drift. Mr. Loreta is to be highly congratulated on these results. (He is also actively interested in work on meteor heights, his contributions to this field being published in Italy.) I wish to call the attention of all our observers to what he has accomplished, and to urge each to have an opera or field glass at hand when observing meteors, and to try to follow with it the changes of any conspicuous train. Any observable drifts or alterations of shape or size should be plotted on the map or drawn on a separate sheet if necessary.

A full account of the Perseid and Delta Aquarid showers as reported to us will appear in later "Meteor Notes."

Three brilliant fireballs have been seen from Philadelphia since March, and from 100 to 250 observations on each are at hand. Much work has been done on all of them. Results of the completed calculations for the fireball of July 16 are given below.

The fireball appeared at 7:50 P.M., E.S.T., while twilight was still strong enough to prevent the use of stars as reference points. The skies in this part of the country were also not entirely clear, so that many observers saw the object only between cloud masses or through thin clouds. As the path was very long (504± km), the majority saw only part of it, and in general the latter part. Because of the early hour, no professional and few amateur astronomers saw it, and we must depend upon "deal reckonings," most of them from untrained people. However, by the usual drastic process of selection and rejection, I have been able to determine a path which fits, within reasonable limits, the data of most of the better observers. It is not improbable that the end height was actually somewhat less than that finally adopted, but this would affect the slope very little.

The object must have had an angular diameter of about 15′, and it was certainly blue-green in color. It left no long-enduring train, but was followed immediately by a short tail or flare, probably 1° or 2° long, the color of which is variously described. No authentic sound phenomena are reported. We have the usual variety of estimates of duration, and most observers describe the motion as "slow." The apparent slowness was an illusion due to the very long path and the duration of about 5.3 seconds. Despite the fact that the body overtook the earth, its velocity in our atmosphere, as computed, was about 95 km/sec. As the

duration is very uncertain and the adopted length of path is probably too great, I have no confidence in the actual figure for velocity. We know only that the velocity was high and almost certainly hyperbolic.

As usual in such cases, the parabolic velocity was assumed and the orbit calculated on this basis. The numerical results are given in the accompanying table.

Date	1936 July 16.52, G.M.T.	
Began over	$\lambda = 78° 00'$	$\phi = 42° 45'$
Ended over	$\lambda = 74° 00'$	$\phi = 39° 48'$
Sidereal Time at End Point		$233° 10'$
Beginning Height		233 km
End Height		39 km
Length of Path		504 km
Projected Length of Path		465 km
Duration	5.3± sec	(uncertain)
Apparent Velocity	95± km/sec	(uncertain)
Radiant (uncorrected)	$a = 135° 00'$	$h = 22° 30'$
Zenith Correction (parabolic)		$3° 38'$
Radiant (uncorrected)	$a = 135° 00'$	$h = 22° 30'$
	$\alpha = 128° 08'$	$\delta = 46° 08'$
	$\lambda = 118° 32'$	$\beta = 26° 24'$
Orbit (parabolic)	$\iota = 42°$	$\pi = 186°$
	$\Omega = 114°$	$q = 0.66$

The press gave us hearty coöperation, and about 220 people sent in reports on this fireball. It must have been very large to attract so much attention, all the way from northern Virginia to central New York. Had it appeared after dark, it would have been most spectacular and brilliant. Its end point was just off the New Jersey coast line, a few miles north of Barnegat City. According to my calculations, it began over Livingston County in New York. We greatly regret the perpetual scarcity of fireball reports from central Pennsylvania and all of New York State except the extreme southeast corner. Cannot we induce someone in these large areas to become an active observer?

Flower Observatory of the University of Pennsylvania,
Upper Darby, Pennsylvania, 1936 September 19.

The Meteor of June 12, 1931

By Bemrose Boyd.

On the evening of June 12, 1931, a brilliant meteor was observed by the writer from Keokuk, in eastern Iowa, and reported to the Midwest Meteor Association. It was also observed by Robert N. Wolfe from Carson, in western Iowa. Requests for reports by observers of the meteor, broadcast from radio station WOI and sent out by the Weather Bureau, brought only the information that it (or some meteor falling at about that time) was seen from Creston, Oskaloosa, Estherville, and Webster City, Iowa. These reports did not contain any angular measurements. The Keokuk and Carson reports were, however, sufficiently complete to be used in calculating the path.

Brightness

The brightness was reported from Carson as "about twice the brilliance of Venus at its maximum brilliance," and from Keokuk as "several times brighter than Jupiter." Considering that the subjective estimate "several times brighter" should probably be interpreted as a compromise between "several times brighter" and "several magnitudes brighter," we may assume that the magnitude was prob-

ably very close to —5. This fact, together with the scarcity of reports, indicates that the meteor was intermediate in brightness between those ordinarily covered by reticle observations and those for which we can contact numerous observers by requests published in newspapers or announced by radio.

General Appearance and Time

All stations reporting the time (Keokuk, Carson, and Estherville) gave 8:45 P.M. Keokuk, Carson, Creston, and Oskaloosa all gave the color as blue-white. Keokuk and Creston reported tongues of flame extending from the sides, and Webster City reported that a trail remained after the meteor had passed.

Reduction of Data

The Keokuk data included a path drawn on a star map and also independent measurements of altitude and azimuth using a magnet mounted on a pivot to determine magnetic north. A difference of about 14° between the measured azimuths and the values computed from the plotted points remained after correcting for magnetic declination. Assuming an error of this magnitude due to asymmetry of the crude form of compass, corresponding altitudes and azimuths in the two independent sets of measurements agreed within one degree. The values from the plotted path were used, except for the altitude of the ending, for which the measured altitude was considered more accurate since this point was not in as good a star field as was the beginning. This choice of values makes the apparent slope differ by less than a degree from the reported slope.

For the Carson observer, the meteor disappeared behind some trees so that the intersection of the azimuth lines from there and from Keokuk does not give the end point. This is also apparent from a difference in height as computed from the two observations. The true end point was found by shifting the Carson azimuth, and also changing the altitude in accordance with the apparent slope reported from Carson, until the heights computed for the two places were the same. The computed heights for successive positions of the azimuth line were plotted against the Carson azimuth on rectangular coördinate paper and the correct azimuth was obtained from the intersection of the two curves. This method could be applied to photographic observations from two stations for which the ending of the path on the film may not correspond to the same point on the actual path due to differences in the cameras, films, and sky conditions.

Elements of the Path

The heights of beginning for Carson and Keokuk agree within one mile. The meteor began at a height of 66 miles over a point about 6 miles southeast of Milan, Missouri, and ended at a height of 45 miles over a point about 4 miles southeast of Rothville, Missouri. The ground point was near Versailles, Missouri. The meteor entered the atmosphere at an angle of 25° with respect to a plane horizontal at the ground point. The length of path, from the point where the meteor was first seen to the end point, was 44 miles. The projected length was 37 miles. The ground point was 87 miles from the projection of the end point. The radiant was a point between Polaris and the constellation Cassiopeia. The final position of the radiant tabulated below includes an approximate correction for zenith attraction based on the assumption that the heliocentric velocity was parabolic. With the exceptions noted above, the procedure of reduction was the method of stereographic projection which is used for the more brilliant fireballs.

I wish to express my appreciation to Professor C. C. Wylie who placed the data at my disposal and to Dr. L. R. Wylie who checked the computations. The

data and result are summarized in the following table:

SUMMARY

	Keokuk	*Carson*
Altitude of beginning	35° 57′	23°
Azimuth of beginning	78° 36′	300° 12′ (from south)
Altitude of ending	23° 0′	(not given)
Azimuth of ending	57° 42′	305° 12′ (disapr. not end)
Apparent slope	45° (moving to left)	45° (moving to right)

Time of fall	1931, June 12, 8:45 P.M. C.S.T.
Latitude of beginning	40° 9′ North
Longitude of beginning	93° 2′ West
Height of beginning	66 miles
Latitude of ending	39° 37′ North
Longitude of ending	93° 0′ West
Height of ending	45 miles
Latitude of ground point	38° 36′ North
Longitude of ground point	92° 56′ West
Length of path	44 miles
Projected length of path	37 miles
Altitude of Radiant (uncorrected)	31° 0′ (from ground point)
Azimuth of Radiant (uncorrected)	177° 10′ (from South)
R. A. of Radiant (corrected)	43° 8′
Decl. of Radiant (corrected)	+79° 59′

University of Iowa, September 2, 1936.

Contributions from the Society for Research on Meteorites

Edited by FREDERICK C. LEONARD, President, *and* H. H. NININGER, Secretary

Bacteria in Meteorites*

By CHARLES B. LIPMAN†

For approximately a decade I have been engaged in studying the problem of the survival of bacteria, and to some extent of other microörganisms, in very old and very dry materials ranging in age from 25 years to periods of remote geologic time like the Pre-Cambrian. Purely as a side issue of this important problem I made a search also for bacteria in stony meteorites. I call this a side issue because no one knows where the meteorites hail from and therefore no one can know how long, if at all, the bacteria which they may contain have been there in a resting as distinguished from an active vegetative state. In other words, I wish to make it very clear and very emphatic that my studies on the meteorites have no bearing whatever in the present state of our knowledge on the problem of the survival of bacteria in materials whose age is known exactly or approximately. The two subjects are quite distinct and I do not wish them to be regarded as the same by persons whose forte is not so much clear thinking as clear shouting and denunciation. In other words, then, I examined stony meteorites for bacteria just to satisfy my curiosity on that point alone and not because that study had any bearing on the important subject which has for so long absorbed my spare time and

*Read at the Fourth Annual Meeting of the Society, University of California at Los Angeles, June 23 and 24, 1936.

†Dean, Graduate Division, University of California, Berkeley.

energy, namely, the survival of bacteria for very long periods of time in a living though inactive state, nor because it had any necessary bearing on other subjects, as some people think and as I shall state in my concluding words.

When I undertook the study of the stony meteorites, there was no evidence, and there is not any now, so far as I am aware, that anybody had preceded me in a similar undertaking. In fact, even today, so far as I am aware, only one other person has worked on the problem and that is Mr. S. K. Roy[1] who decided to do so only after the paper telling of my findings appeared. In other words, I was and am the pioneer on this subject, and since the only other person who can speak on the basis of his own experiments on this subject denies and refutes my findings, I wish to pay my respects to his work and his views today.

Mr. Roy introduces his paper by citing and commenting upon some of my papers dealing with the discovery of living bacteria in Pre-Cambrian rocks and in anthracite coal. I have already stated to you that that work and the work on the stony meteorites are distinct, and the results in the two cases have little or no bearing on each other. The only reason that I can find for his bringing them into the discussion is that it gives him an opportunity to state that Farrell and Turner said they had failed to corroborate my results on anthracite coal. He fails to state that they got similar results to mine but chose deliberately to interpret them differently. What is more important still is that Mr. Roy fails to mention that Lieske, one of the most distinguished of German bacteriologists, got results on anthracite coal which were exactly like mine. Lieske and I were unaware of each other's work until I had published my paper, Farrell and Turner had put in their demurrer, and Lieske published a paper supporting my findings precisely, except for his belief that the organisms in anthracite coal carry on a weakly vegetative existence, while it is my conclusion that they exist there in a resting state. In other words, while citing results which are not really relevant to my study on meteorites Roy does not cite both sides but only the one which suits his purposes; and mind you, that was after I had stated in print that Lieske had obtained results like mine and that our work was mutually confirmatory.

Now as regards Roy's experiments: He states that he wished to "adhere as closely as possible to repetition" of my technique. Please note how he did so. He used similar media to mine and in certain other ways followed my technique but in one of the most crucial phases of the experiment he deviates so strikingly from my procedure that all of his other precautions to follow me are rendered futile and Roy is on a totally different trail. I refer to his choice of very small specimens of meteorites, the largest weighing only 8.65 grams. I have pointed out emphatically and on several occasions that the bacterial populations of rocks and similar materials are never more than very sparse. I have shown that in single specimens of rock like anthracite coal ten to twenty times the size of the largest meteorite specimen which Roy studied, it often occurs that there are no bacteria. The smaller the specimen of meteorite, therefore, the less chance there is of discovering any bacteria in it. In the specimens used by me which Roy describes specifically in his paper it will be seen that except for one duplicate fragment the *smallest* specimen I used weighed 109 grams or approximately 13 times the weight of Roy's largest specimen. The reasons Roy gives for using small specimens instead of large ones such as I used are as follows in his own words: "Stony

[1] "The Question of Living Bacteria in Stony Meteorites," by Sharat Kumar Roy, *Geological Series of the Field Museum of Natural History*, **6**, No. 14, December 12, 1935.

meteorites larger than 10 grams are seldom completely crusted. In studies of this nature the importance of complete encrustation cannot be overestimated, for the crust not only insures retention of the contents of the interior of the meteorites in their original form and condition, but also serves as a natural protection against the ingress of bacteria from dust and air." This statement is at least naïve, not to say amusing, when one notes in the photograph which Roy gives of the specimens he used that at least two and perhaps three of the four were not completely crusted. I can show a large specimen which I have that is just as completely crusted as Roy's largest specimen but Roy does not realize that the photograph which he publishes takes the props right out of his most important argument for using small specimens, and he has yet to answer the grave objection to small specimens which I have just stated. His only attempt at an answer is that from a report published in England he learns that soils may contain 100,000 to 1,500,000 bacteria per gram. Indeed they may contain many times those numbers as I know at first hand, but soils are not rocks. Conditions are excellent in soils for rapid reproduction of many soil microörganisms, but not so in rocks. It is probable that only resting stages like spores can survive in rocks and only a few of them. This is especially true when long periods for survival are in question.

But if a broken crust on a meteorite permits ingress of bacteria as Roy claims, why should his specimens have been exceptions to the rule? But Roy does not appear to realize that he "can't eat his cake and have it too." After going to great pains to prove, as he thinks, that meteorites with broken crusts can be easily contaminated, which claim I have just shown to be unproved, he tells us that bacteria could not have survived in meteorites because they do not find there food and other conditions for their growth. Such a statement certainly shows a lack of knowledge of and experience with bacteria. Many forms of bacteria, at least, go into the spore state when conditions are unfavorable in the respects just noted or in many other respects and remain quiescent until proper conditions for their growth supervene, when the spores germinate and the new organisms again carry on an active existence. If the necessary conditions for active life do not supervene the organisms may remain in the spore state indefinitely in the case of some forms of bacteria. In this way, therefore, bacteria may survive the unsatisfactory conditions of meteoritic matter contrary to what Roy thinks. This, moreover, is not surmise but well authenticated statement. I can furnish all the proof you want on that score if you will give me the time to do so. But when Roy says that bacteria cannot live in solutions consisting of rock powder or meteorite powder he shows again his limited experience with microörganisms. All assiduous students of general microbiology know this is not so because organisms have been found which have grown in a 10% solution of C.P. $BaCl_2$, in $N/10$ HCl (C.P.), in saturated $CuSO_4$ solutions (C.P.), *etc.* Is there any likelihood of more adequate food supply in these materials than in rock-powder extract? And mind you there were vegetative growths, not mere spore survival. But if this means survival, as it most assuredly must, either of the spore or of the vegetative state, please note what has become of Roy's arguments. I must pursue this matter still further. Roy makes some statements which he does not support or in which he contradicts himself. For example, he says "it has been known and later experimentally proved that *water with bacteria* can seep through stony meteorites (p. 196) when they are in contact with the earth." We turn to page 196 and find that all he has proved is that meteorites take up water. There is not a word of proof in his paper to the effect that they take up bacteria with the water. Water will penetrate many substances which may remain impenetrable to the things which water car-

ries in solution or in suspension. A little knowledge of the literature of physics, physical chemistry, and biology establishes the truth of this statement.

Roy argues further that because he found no bacteria in pebbles of peridotites and basalt "the possibility of bacteria surviving in stony meteorites is very small." My experience with densities of peridotites and basalts does not bear out Roy's claim for a close resemblance between their structure and that of stony meteorites. In fact, I find stony meteorites to be very porous as compared with the peridotites and basalts. Moreover, we know that basalts are igneous in origin, but no one knows of the immediate origin of stony meteorites, even if we should grant that the matter from which they were formed originally was igneous in origin. Following the statement I have just quoted from Roy he makes the further statement: "This was later confirmed by the negative results obtained when terrestrial bacteria, both bacilli and cocci, were inoculated in a culture medium consisting of meteorite powder and distilled water." I cannot find a word of evidence in his paper to support that, and he does not tell us whether he used spores or vegetative forms. Roy does not realize, moreover, that this statement of his is one of the many contradictions in his paper. If bacteria cannot live in suspensions of stony meteorite powder and water and if the surface of a meteorite before crushing is assuredly sterile how can meteorites become contaminated? Of course, he answers this by saying that the contaminants he finds are in the air of the operating chamber. But did he ever stop to think that there is something too perfect in his having found just one coccus and one bacillus as contaminants, and more marvelous still, that exactly those two organisms and no others were found in the so-called contaminated cultures and in the plates exposed to the air? The perfection of this coincidence is just too good to be true! While I am on the subject of contaminants I wish to point out that the relegation by Roy of the bacteria which I found in meteorites to the category of contaminants is a most arbitrary one if one recalls that my working conditions were no less aseptic than Roy's and still I found a considerable variety of bacteria in meteorites instead of just one bacillus and one coccus as did Roy, and I found the greatest variety and number in the specimen—the Johnstown, Colorado, meteorite—which had had the least period of contact with the earth. When Roy takes me to task for saying that this "meteorite had little or no contact with the earth," I answer that my authority for the statement was the man who made it possible for me to obtain the specimen, namely, Dr. O. C. Farrington.

Time will not permit my critical examination of a number of other questionable features of Mr. Roy's paper, but before making my closing statement I wish to answer an assertion made by Roy that I am guilty of a "glaring contradiction" when I state that geologists informed me that meteorites, and especially stony meteorites, never become hot except on the surface when passing through the earth's atmosphere, and therefore the bacteria in the center might be secure, and elsewhere in my paper state that some bacteria in one of my meteorite specimens must have been killed by heating the meteorite in my large gas burner for 20 seconds. Roy asks "how could bacteria, if any, in a meteorite be destroyed by heating 20 seconds in a gas flame when they are not supposed to be destroyed by the intense heat which literally fuses the surface of the meteor during its passage to the earth?" Roy's question is easily answered and with the answer the contradiction of which he accuses me vanishes into thin air. Twenty seconds' exposure of a meteorite to a temperature of 1300° C. constitutes about ten times the exposure to heat which a meteorite suffers in its trip to the earth. It does not begin to burn until it develops friction on contact with the earth's atmosphere, but the earth's

atmosphere is so thin that it cannot take more than two or three seconds for a meteorite to pass through it. Furthermore, it will be noted that I did not say *all* the bacteria in the meteorite were killed by heating the latter for 20 seconds in a flame yielding approximately 1300° C. but only "some," just as "some" might conceivably have been killed in the meteorite during its journey to the earth. But all this could be only when the conduction of heat from the surface to the interior of the meteorite is good enough. Stony meteorites are very heterogeneous and very variable in mineral as well as chemical composition. The higher the metallic content the better the conducting powers of the meteorite for heat, but only in certain streaks or lines in the interior of the meteorite, not uniformly, as Roy thinks, when the time of exposure to heat is very short.

In closing this polemic I submit that the only person so far as I am aware who besides myself has actually searched for bacteria in meteorites, namely Mr. Roy, has presented a report of his research which does anything but prove that my facts and conclusions are in error. Starting out with the purpose of duplicating my technique in his experiments he soon modifies it so as to render his results worthless as a test of my findings and conclusions. Until better critical examinations than Roy's of my work can be brought forward my results and conclusions remain good. My final observation deals with the repeated statements or implications by Roy, and also by Hudson who wrote the introduction to Roy's paper, to the effect that I was directly hinting or attempting to prove by my results on bacteria in meteorites the extra-terrestrial origin of life. They are absolutely mistaken in this as in other things. I neither hinted at this nor stated it. In fact, if they will take the trouble to look up my paper in *The Scientific Monthly* (**19**, 357-67, October, 1924), written twelve years ago or more, they will find that I have published a very different theory of my own relative to the origin of life; and I still hold that theory. My paper on bacteria in meteorites was intended for nothing more than to give the facts of the situation. The origin of life has nothing to do with the case. What may be pertinent to the discussion is the application of my results to the question of whether life exists on other bodies in space besides the earth. It is this inability on the part of some people to keep from regarding distinct subjects as the same which makes so much trouble in scientific literature, as, for example, the present polemic makes for you!

Report of the Fourth Annual Meeting of the Society

The Fourth Annual Meeting, held at the University of California at Los Angeles on June 23 and 24, 1936, was the best attended and in practically every other respect the largest meeting in the history of the Society up to date. The following nineteen members were present at one or more of the various sessions on the two days (unless mentioned, the State is California): Lyle Abbott and Mars F. Baumgardt (Los Angeles), L. F. Brady (Flagstaff, Arizona), John Davis Buddhue (Pasadena), Ernest W. Chapman (Alhambra), Walter B. Clausen (Pacific Palisades), Howard R. Hill and Louis V. Kenkel (Los Angeles), Arthur S. King (Pasadena), Frederick C. Leonard (Los Angeles), Charles B. Lipman (Berkeley), Ransom Matthews (Los Angeles), Ralph I. Meeker, Jr., and H. H. Nininger (Denver, Colorado), Harry K. Sargent, Nathan Schwartz, Archie Wade, and Robert W. Webb (Los Angeles), and Walter T. Whitney (Claremont); in addition, a goodly number of guests attended. Fourteen technical papers, two from foreign members, and two popular lectures were delivered. Following are the program and the list of papers read:

PROGRAM OF THE FOURTH ANNUAL MEETING

The President of the Society presiding

Tuesday, June 23

10:00 A.M.: Session for Papers, including (1) Address of Welcome by Dr. Robert G. Sproul, President of the University of California, and (2) a Business Meeting, at which certain proposed Amendments to the Constitution and to the By-Laws (circulated with the call for the meeting) were unanimously adopted and the Articles of Incorporation of the Society were officially approved.
12:30 P.M.: Recess for Luncheon, Kerckhoff Hall.
2:00 P.M.: Popular Illustrated Lecture on "The Meteorite Crater of Arizona," by Dr. Mars F. Baumgardt of Los Angeles, followed by Session for Papers.
6:00 P.M.: Informal Dinner for Members of the Society and their Guests (about twenty present), Kerckhoff Hall.
7:00 P.M.: Excursion to the Griffith Observatory and Planetarium, Griffith Park.
8:00 P.M.: Planetarium-demonstration Lecture at the Observatory, on "A Trip to the North Pole" (including artificial displays of the aurora borealis and a shower of meteors), by Dr. Dinsmore Alter, Director, followed by Inspection of the Observatory and its Collection of Meteorites, and Observations through the 12-inch Telescope.

Wednesday, June 24

9:00 A.M.: Meeting of the Council (present, four members: the President, the Secretary-Treasurer, and Councilors Brady and Whitney).
10:00 A.M.: Session for Papers.
12:30 P.M.: Recess for Luncheon, Kerckhoff Hall.
2:00 P.M.: Session for Papers, concluding with Informal Reports by Chairmen and other Representatives of Committees in Attendance at the Meeting. Adjournment.

The scientific sessions, all of which were open to the public, convened in Room 310 of the Chemistry Building of the University; the meeting of the Council was held in an office of the Department of Astronomy (Room 343 of the same building). The Leonard collection of meteorites, on display in the Geological Museum (Room 300), was open for inspection during the entire time of the meeting. At its session on June 24, the Council voted that the Fifth Annual Meeting of the Society shall be held in June, 1937, in conjunction with the combined meetings of the A.A.A.S. and its Western Divisions, in Denver, Colorado.

LIST OF PAPERS PRESENTED AT THE FOURTH ANNUAL MEETING

(1) *"THE SPECTRA OF METEORITES" (an invited paper): Dr. Arthur S. King, Superintendent, Physical Laboratory, Mount Wilson Observatory of the Carnegie Institution of Washington, Pasadena, California.

(2) "A METEOR SPECTRUM": Mr. John S. Hopkins, Brackett Observatory, Pomona College, Claremont, California (introduced by Dr. Walter T. Whitney and paper read by him).

(3) *"BACTERIA IN METEORITES": Dr. Charles B. Lipman, Dean, Graduate Division, University of California, Berkeley, California.

(4) *"SOME REMARKS ON THE PHYSICAL PROBLEMS INVOLVED IN THE CRYSTALLIZATION OF IRON IN A GRAPHITIC MATRIX IN METEORITIC MATERIAL": Mr. L. F. Brady, Principal, Mesa Ranch School, Mesa, and Curator of Geology, Museum of Northern Arizona, Flagstaff, Arizona.

(5) *"ON THE MEASUREMENT OF METEOR VELOCITIES": Dr. Walter T. Whitney, Director, Brackett Observatory, Pomona College, Claremont, California.

(6) *"WHY IS A METEOR?": Professor H. H. Nininger, Director, Nininger Laboratory, and Curator of Meteorites, Colorado Museum of Natural History, Denver, Colorado.

*Papers marked by an asterisk were presented personally by their authors.

(7) *"TERMINOLOGY IN METEORITICS": Professor H. H. Nininger (read, at the author's request, by Dr. Leonard).
(8) *"FURTHER REMARKS ON METEORITICAL TERMINOLOGY": Dr. Frederick C. Leonard, Chairman, Department of Astronomy, University of California at Los Angeles.
(9) "THE TEKTITE PROBLEM" (an invited paper): Dr. L. J. Spencer, Keeper of Minerals, British Museum of Natural History, London, England (read by Mr. Brady).
(10) "SOME METEORITIC FALLS IN OR ABOUT THE CITY OF HYDERABAD, DECCAN, INDIA, AS REPORTED BY EYEWITNESSES": Professor Mohd. A. R. Khan, Principal, Osmania University College, Hyderabad, Deccan, India (read by Dr. Whitney).
(11) *"DOUBTFUL METEORITES": Mr. John Davis Buddhue, 99 South Raymond Avenue, Pasadena, California.
(12) *"COMPOSITION VERSUS STRUCTURE OF IRON METEORITES": Mr. John Davis Buddhue.
(13) "THE FIREBALL OF AUGUST 11, 1934": Mr. J. Wesley Simpson, 639 Locksley Place, Webster Groves, Missouri (abstracted by Dr. Whitney).
(14) *"RECENT INVESTIGATIONS REGARDING THE EXTENT OF THE METEORITIC SHOWERS NEAR PLAINVIEW, HALE COUNTY, TEXAS, AND HAVILAND, KIOWA COUNTY, KANSAS": Professor H. H. Nininger.

The Society Incorporated on July 27, 1936

At the Fourth Annual Meeting, the Articles of Incorporation of the Society, as drawn up by the Committee on Incorporation—consisting of the President and the Secretary *ex officiis* and one specially appointed member, Mr. Nathan Schwartz, A.B., LL.B., C.P.A., of Los Angeles—were unanimously approved by the members present at the business session held on the morning of June 23. The Committee has now to report that on July 27, 1936, the Society became incorporated as a non-profit corporation under the laws of the State of California. The thanks of the other two members of the Committee are due Mr. Schwartz, who did all of the legal work connected with the incorporation. Having concluded its business, the Committee is hereby discharged.

FREDERICK C. LEONARD, President of the Society and
ex officio Chairman of the Committee on Incorporation

1936 July 30

Secretary's Office: Nininger Laboratory, 1955 Fairfax Street, Denver, Colorado.
Editorial Office: Department of Astronomy, University of California at Los Angeles.

A Meteorite from Quartz Mountain, Nevada

An iron meteorite was discovered April 24, 1935, five miles southeast of Quartz Mountain, in central Nevada. The find was made, on the Manitouac mining property, by miners while removing surface material preparatory to driving a tunnel.[1] The meteorite lay upon bedrock under about two feet of surficial detritus. The nature of the specimen was recognized through tests conducted in the Nevada State Analytical Laboratory where it was submitted for identification. Particular interest is attached to this discovery as this is the second meteorite so far reported from Nevada. The site of the discovery was visited and an examination made of the area. The evidence indicates that the meteorite came to rest in the shallow overburden at the point of discovery.

The Quartz Mountain iron is an octahedrite, weighs 4832 grams (10.6 pounds),

[1] The meteorite was discovered by Mr. John T. Waldis to whom the writer is indebted for information regarding the find. Mr. Leslie Green presented the specimen to the Mackay Museum, University of Nevada.

and has a specific gravity of 7.67. It is composed principally of iron. Qualitative tests indicate a considerable amount of nickel and traces of cobalt and copper. No tests were made for other elements. The specimen is roughly conical in outline, as shown in Figure 1. Its largest cross-section is roughly triangular, measuring five inches across the base and six inches in height. The greatest thickness

FIGURE 1

THE QUARTZ MOUNTAIN, NEVADA, METEORITE

View showing the conical side covered with many conical depressions. Width 5 inches, height 6 inches, thickness 3 inches, weight 4832 grams.

is three inches, measured perpendicular to the largest cross-section. One side is relatively flat and fairly smooth while the other, shown in the illustration, is crowned outward toward the center. This side is pitted by conical depressions rounded at the bottom. A coating of iron oxides gives the meteorite a dark reddish-brown color, with light-reddish, to yellowish, splotches. The oxide layer is quite thin as a shallow scratch will expose the bright, unoxidized metal beneath. No trace was found of the dark fusion crust which is usually present in recent falls. As the iron was found in an arid region the absence of the fusion crust suggests an ancient fall.

The large rounded depression, shown at the right in the illustration, has a

thin white coating of water-deposited material. Near this depression is a nearly plane surface one and one-half inches in diameter. This surface is nearly smooth except for small jagged projections, such as would result from fracture. A fracture, almost three inches long, penetrates deeply into the meteorite. Other smaller fractures are present. The fracturing and the jagged surface, mentioned above, suggest that this is but part of a larger meteorite and that other fragments remain to be discovered. However, no other fragments were found during a short search in the vicinity of the fall.

The only other, definitely determined, meteorite from Nevada is the Quinn Canyon iron, discovered in 1908, from the Quinn Canyon Range, 100 miles east of Tonopah. Jenney[2] thought that the Quinn Canyon iron caused the great meteor which passed over California and Nevada during the night of February 1, 1894. If such is the case it would represent the largest meteorite fall witnessed in the United States. The condition of the Quinn Canyon iron suggests that it is an old fall.

VINCENT P. GIANELLA.

Mackay School of Mines, University of Nevada, Reno, Nevada.

[2] Jenney, Walter P., The Nevada Meteorite, *Mining and Scientific Press* 98: 93-94, 1909. The Great Nevada Meteor of 1894, *Amer. Jour. Sci.* (4) 28: 431-434, 1909.

Fireball Observed in North Dakota

I was in my yard observing variable stars with my telescope on the evening of August 14, when at 9:15 P.M., C.S.T., a bright fireball appeared near π Herculis, and vanished two seconds later about five degrees south of Arcturus. It was about half as bright as the full moon, about ten minutes of arc in diameter, and gave a bluish light that illuminated the landscape and cast strong shadows. It left a reddish train which faded rather rapidly.

NOAH W. MCLEOD.

Christine, North Dakota, August 15, 1936.

Perseid Observations

The following report has been sent in by Mr. Hugh Johnson:

On August 9 there were no very bright meteors or exceptional ones. Most fell between 1:00 and 1:30 A.M. Their color was generally yellow and indicated a radiant very near α Persei. Seventeen meteors were noted.

On August 10 the sky was totally cloudy and no observations were possible.

On August 11 a very bright meteor was seen moving from northeast to southeast, about 30° above the horizon. At least a hundred were seen on this night. One characteristic was that a great many fairly bright yellow meteors left trails and a sort of *dusty* looking path. Two bright fireballs were seen near Perseus of white color. August 12 did not hold much interest.

3207 Cornell Street, Des Moines, Iowa, August 17, 1936.

Comet Notes

By G. VAN BIESBROECK

COMET PELTIER (1936 *a*). During the latter part of July and the first days of August many observers have watched this comet as it approached and passed minimum distance from the earth. It was then bright enough to be seen with the naked eye in spite of the moonlight. Its total magnitude reached 3^M on August 1. The head was at that time about ⅔ the size of the moon in apparent diameter and

the broad structureless tail extended to 40′ from the nucleus, which remained sharp throughout.

The swift southerly motion put an abrupt end to the visibility for northern observers after the first week in August. So far no reports have been received of further observations in the southern hemisphere, but the expected rapid reduction of brightness will probably soon have terminated the period of naked-eye visibility.

Comet Kaho-Kozik-Lis (1936 *b*). The discovery of this bright comet was mentioned in the August-September number. The third name added to its designation is that of a Polish observer who found the object independently on Mt. Lubomirs near Cracow, and reported a long symmetrical tail.

The comet was followed by many observers although it was visible only at low altitude shortly after sunset. The latest evening observation before conjunction with the sun seems to be that by Peisino who followed the object until August 3 at Trieste.

The preliminary elements given on p. 393 were already close to the truth. The orbit is evidently well determined since several computers gave nearly the same elements. Those computed by A. D. Maxwell and H. R. J. Grosch representing observations up to July 30.11 are so far the most accurate.

Elements of Comet Kaho-Kozik-Lis (1936 *b*)

Perihelion	= 1936 July 15.84294	
Node to perihelion	= 45° 54′ 13″.32	1936.0
Longitude of node	= 264 10 25.33	
Inclination	= 121 56 47.10	
Perihelion distance	= 0.5182627 astronomical units	

The following ephemeris kindly supplied by Dr. Maxwell will locate the comet during October.

Ephemeris of Comet 1936 *b*

1936 U.T.	α h m s	δ ° ′	Distance from sun	Distance from earth
Oct. 7.0	9 4 17	+33 23.8	1.725	1.874
15.0	8 54 20	33 29.2	1.848	1.828
23.0	8 41 32	33 41.6	1.968	1.776
31.0	8 25 20	33 57.6	2.086	1.723
Nov. 8.0	8 5 18	+34 11.6	2.202	1.676

It has now become a morning object, moving slowly westward along the limits of the constellations of Lynx and Cancer. A first morning observation was obtained by the writer on August 29 when shortly before dawn the comet appeared as a centrally condensed round coma of about 12th total magnitude. The brightness is therefore enormously reduced as predicted by the computation, and with increasing distance from the sun the comet is expected to become more and more difficult to follow, although its position in the night sky improves.

So far the measures are fairly well represented by the ephemeris so that the orbit is substantially correct. In particular the deviation from parabolic motion will be slight so that the period must be very long.

Further observations have been made here on Comet Van Biesbroeck (1935 *d*) which is now reduced to magnitude 16.5 (September 19). The period of visibility extends well over a year now so that an accurate determination of the orbit will be possible. An unfortutnate error crept in the computed right ascension of the ephemeris on p. 392. The corrected figures are given in the Circular 612 of the International Union. On September 19 the residual, observed minus computed, was: —1ˢ and —6′.2.

Search for PERIODIC COMET D'ARREST should be continued in spite of its unfavorable position in the evening sky, guided by the following ephemeris:

EPHEMERIS OF PERIODIC COMET D'ARREST

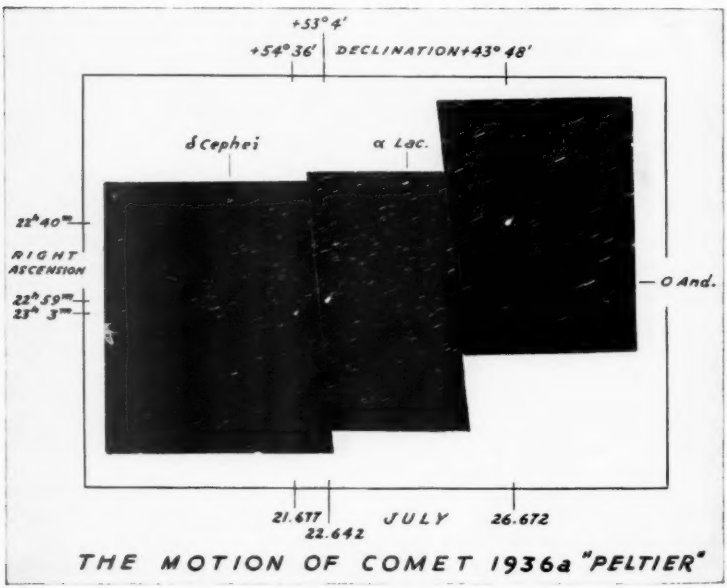
1936	α h m	δ ° ′	Distance from sun	Distance from earth
Sept. 29	15 22.2	— 5 14	1.76	2.31
Oct. 7	15 40.1	7 5	1.71	2.31
15	15 59.3	8 53	1.66	2.30
23	16 19.7	10 37	1.61	2.30
31	16 41.4	12 16	1.57	2.29
Nov. 8	17 4.4	—13 48	1.53	2.28

It is hoped that this object which has not been seen since 1923 can be detected before its conjunction with the sun.

Williams Bay, Wisconsin, September 19, 1936.

Three Photographs of Comet Peltier (1936 a)

Having had the good fortune to experience three exceptionally fine nights during the latter part of July, I was able to obtain a four hour exposure of the comet on each one of them.



The camera used was equipped with a 3-inch Ross type lens of 21 inches focal length. Since, with this instrument, the field of a 5-inch by 7-inch plate is quite extensive (12° by 17°), it was possible to join the three photographs, thus showing the motion of "Peltier" among the stars during five days. Also, it may be seen from the relative lengths of star trails made while taking the equal exposures

of July 21 and 26, that the comet's speed, with reference to its stellar background, had doubled during this interval.

Comment upon the accompanying figure: (a) The emulsion used was Eastman 40. (b) The scale of each print (which are contacts taken from the plates without intermediate copying) is half a degree equals the length of the longest star trails. (c) The comet's tail may be traced for about half a degree, though the original negatives show it to be slightly longer. (d) Fractional dates refer, as is usual, to Greenwich mean noon. They are computed for the beginning of each exposure. (e) Each of the three sets of coördinates was found by interpolation from places given in B.A.A. Circular No. 171, June 13. (f) Some of the brightest stars are marked. Nova Lacertae 1936 is just off the first plate above δ Cephei.

PHILIP TAYLOR.

The Warner and Swasey Observatory, Cleveland, Ohio, August, 1936.

VARIABLE STARS

Variable Star Notes from the American Association of Variable Star Observers

By LEON CAMPBELL, Recorder

New Observers: The following are new contributors to the reports of the A.A.V.S.O. during July and August: Joseph Ashbrook, Baltimore, Maryland; Ralph S. Bates, Rochester, New York; Takakazu Kawai, Dairen, Japan; H. F. Lewis, Reading, Pennsylvania; George O'Hare, Brooklyn, New York; James S. Russell, Cleveland, Ohio; Robert Schmid, Ottumwa, Iowa; Sugiura Shinzo, Aichi, Japan; Carl Strelitzer, Milwaukee, Wisconsin; Etsuo Ushiyama, Gifu, Japan; Carl H. Whittier, Reading, Massachusetts; Gordon Zeese, Great Neck, L. I., New York.

Observations: Part 2 of *Harvard Annals* 104, containing approximately 8,600 observations received at headquarters during the months of February, March, and April, 1936, is in print and awaiting distribution to contributing observers. Part 3 is about to go to press and contains approximately 11,400 observations on 463 variable stars by 107 observers. A list of the contributors during July and August follows:

	July		August			July		August	
Name	Vars.	Obs.	Vars.	Obs.	Name	Vars.	Obs.	Vars.	Obs.
Adamopoulos	.	.	1	22	Chandra	70	110	.	.
Ahnert	22	91	27	182	Chartier	.	.	6	6
Ancarani	.	.	3	11	Christman	34	39	42	48
Ashbrook	.	.	11	16	Cilley	.	.	50	148
Ballhaussen, Miss	9	23	9	13	Dafter, Mrs.	7	30	.	.
Bappu	25	60	.	.	Dahm	24	52	21	33
Bates	.	.	2	2	Dalton	6	21	7	16
Beck	3	6	.	.	Doolittle	26	65	25	39
Blunck	55	112	57	99	Ellis	29	46	49	89
Bouton	21	23	.	.	Ensor	59	137	65	128
Brockmeyer	4	20	3	7	Fairbanks	9	19	5	11
Brown, S. C.	8	8	17	17	Fish	3	3	.	.
Brydon	1	6	.	.	Focas	1	16	101	264
Buckstaff	25	138	23	104	Franklin	8	8	.	.
Callum	39	68	25	40	Gaposchkin, S.	1	22	1	6
Cameron	6	11	6	8	Gregory	130	277	.	.

Name	July Vars.	July Obs.	August Vars.	August Obs.	Name	July Vars.	July Obs.	August Vars.	August Obs.
Haas, W.	7	13	.	.	Perkinson	3	10	.	.
Halbach	27	31	.	.	Purdy	5	34	.	.
Hamilton	25	105	18	70	Raphael	9	22	.	.
Hartmann	107	257	123	303	Recinsky	9	43	8	42
Hassler	21	22	19	29	Reed, D. S.	1	19	.	.
Herbig	33	188	50	291	Rosebrugh	29	85	27	158
Hiett	11	32	11	33	Roth	2	2	.	.
Hildom, A.	26	60	26	52	de Roy	10	33	10	56
Holt	28	47	31	31	Russell, J.	1	1	4	8
Houghton	78	187	68	207	Salanave	20	47	.	.
Howarth	15	15	.	.	Scanlon	.	.	11	11
Howes	7	21	.	.	Schattle	.	.	13	80
Jacobs	1	9	.	.	Schmid, R.	2	4	.	.
Jensen	5	5	2	2	Seely	10	37	13	55
Jones	95	217	128	467	Segers	4	38	.	.
Kanda	.	.	1	29	Shinkfield	26	52	.	.
Kawai	.	.	2	24	Shinzo	.	.	1	5
King	5	6	9	13	Sill	.	.	11	21
Kirkpatrick	13	77	14	96	Smiley	1	9	.	.
de Kock	28	125	30	82	Smith, F. P.	.	.	15	18
Kohman	4	14	.	.	Smith, F. W.	10	24	1	4
Koons	21	22	54	61	Smith, L.	.	.	1	2
Lewis	.	.	5	9	Smith, L. L.	1	5	.	.
Loreta	40	91	55	118	Strelitzer	.	.	16	25
Luczka	5	9	.	.	Thomas, Mrs.	1	13	1	6
Marshall	1	9	21	91	Thorndike	6	22	8	11
Mennella	.	.	14	49	Thorne	10	11	.	.
Millard	26	80	.	.	Treadwell	10	37	8	26
Mitchell, R.	4	6	19	61	Ushiyama	1	5	.	.
Moore	6	8	.	.	Watson	15	44	.	.
Murphy	7	22	11	23	Walton	10	27	.	.
McLeod	16	36	32	92	Webb	26	41	45	80
McNeill	7	19	6	18	Whitney	.	.	1	7
O'Hare	1	8	.	.	Whittier	1	1	2	4
Peck	18	141	39	286	Zeese	4	4	1	2
Peltier	155	230	150	210					

Nova Lacertae (221255): Approximately 500 observations on Nova Lacertae have been made by A.A.V.S.O. observers, and an additional thousand have been published in the various astronomical magazines. Thus, there are now available about fifteen hundred observations covering the history of the Nova since discovery on June 18; until the middle of August not a single night was missed.

Latest information at hand appears to give the distinction of being the original discoverer to Mr. K. Gomi, of Tokyo, Japan. He discovered the star while at an eclipse camp, several hours before darkness came over Europe. That the Nova increased very rapidly in light between June 17 and 18 is evident from the fact that a plate taken at Berlin on June 17 shows no star in the position of the Nova brighter than magnitude 13.0. The Nova, according to the Japanese observers, attained magnitude 2.0, on June 20.0 (G.M.T.). It immediately began to diminish in brightness, by June 25 having dropped to magnitude 4.0, and on June 30 to fifth magnitude. The sixth magnitude was attained on July 8, seventh magnitude on August 1, and the latest observations place the magnitude at approximately 7.8 on September 1.

No marked oscillations such as were found in Nova Persei, 1901, and Nova Aquilae, 1918, have so far been in evidence. The light changes resemble more closely those of the majority of novae found toward the center of the Milky Way, —a very rapid rise, sharp maximum, sudden drop immediately after maximum, to

a more gradual decrease in light towards minimum. Curiously enough, the magnitudes of Nova Lacertae and Nova Herculis, 1934, are at the present time almost the same. There has been a more rapid decline in the light of Nova Lacertae than in that of Nova Herculis, the former taking less than three months and the latter more than a year and a half to reach the same magnitude.

SS Cygni Type Variables: Maxima Nos. 187 and 188 of SS Aurigae occurred, respectively, on March 13 and April 29. Both of these maxima were of the sharp type with slow rise to maximum, similar to that found for No. 186. Maximum 296 of U Geminorum occurred about the middle of May and was of the broad type. This star should be at maximum, probably of the narrow type, at the present time, and if possible should be carefully observed. Maxima 285 and 286 of SS Cygni occurred on May 11 and August 4; both were of the long type, No. 285 requiring more than ten days to go from minimum to maximum. AY Lyrae, with a scheduled range of from 12.5 to [14.5, was observed at maximum, magnitude 13.0, on August 15.

Variable Stars and the American Astronomical Society: The number of papers on variable stars presented at the recent meeting of the American Astronomical Society, held at Cambridge, Massachusetts, was large. Of the sixty papers listed in the program, more than a third dealt with variable stars and nine of these pertained to Nova Lacertae. Several papers dealt with the shells surrounding Nova Lacertae. All agreed that four shells were in evidence, two having a velocity of 1100 kilometers per second at the start and ending with a velocity of 2500 kilometers per second. The other two shells attained a velocity as high as 3500 kilometers per second. It is interesting to note also that Dr. Bobrovnikoff found strong interstellar lines in the red for Nova Lacertae such as Dr. Merrill has found for other stars. J. A. Pearce, of the Dominion Astrophysical Observatory at Victoria, derived a distance of 800 parsecs for Nova Lacertae, corresponding to approximately 2600 light years. This would give an absolute magnitude for the Nova of —7.3, not unlike that of many galactic novae.

A Phenomenal Cepheid: One of the most interesting papers on variable stars was that presented by Henrietta H. Swope on the behavior of a faint star in the Southern Milky Way. Here perhaps we have a Cepheid in the making because, prior to 1928, the star appeared to vary over a small range with minor fluctuations. In 1928 it was found to have a definite period of 14 days with a range of over one and one-half magnitudes. In 1935 the period was found to be 21 days. This, at first glance, would seem almost incredible but the evidence presented by the consecutive light curves covering the years during which the star has been studied leaves no doubt as to the reality of the phenomenal change. No star like this one has ever been known and it may be that we are observing the actual commencement of Cepheid variation, although the changing of period, with its implied changes of density, is baffling.

Changes of Period in Long Period Variables: The contribution of more than a quarter of a million observations by amateur astronomers during the past twenty-five years enabled Campbell and Sterne to present a discussion of the periods of some 370 variable stars of long period. The question under discussion was, "How constant are these periods?" Of the 370 discussed, only about twenty give moderate evidence of a real change in period over many years, while only five of these give decided evidence of changes in period. The most outstanding cases are those of R Hydrae and R Aquilae. The former shows a change in period of 550 days in the middle of the seventeenth century, to about 400 days at the pres-

ent time. The change appears to be linear, with a slowing up during the past ten years. It rather looks as if very few of the long period variable stars undergo progressive changes in period, in spite of the suppositions of astronomers who have studied such changes during the past half century.

A New Celestial "Window": A paper by Dr. Shapley and Miss Boyd indicates another "window" in the absorbing clouds along the Milky Way. The presence of scores of external galaxies on the same plates with Cepheid variable stars of the Milky Way shows that the region is very transparent. More than a hundred new variable stars have been found beyond the galactic center, the first time that this transcenter region has been explored. Five of these variables are more distant beyond the galactic center than the distance from the center to the sun.

Detection of Red Stars: A study made by Dr. Hetzler, of the Yerkes Observatory, of exceedingly red stars by comparing the color index in the infra-red and the yellow regions of the spectrum may lead to remarkable results in connection with the study of red variables. Dr. Hetzler finds some of these stars indicate temperatures as low as 1000° C.

Secretary A.A.V.S.O.: At a special meeting of the A.A.V.S.O. Council held in Cambridge, on September 4, Charles W. Elmer, of Southold, L. I., New York, was chosen to fill the unexpired term of the late Secretary, William Tyler Olcott.

Notes from Amateurs

Chicago Amateur Astronomical Association

At the meeting of the Chicago Amateur Astronomical Association held in the Adler Planetarium and Astronomical Museum, on Sunday, July 12, George E. Warner described the principles of the Schmidt camera. He explained how the correcting plate, placed at the radius of curvature, corrects the spherical aberration of the short focus mirror. This plate is about 3/16 inch thick and has a compound curve which is shaped by grinding and has to be polished every time it is tested.

Carl H. Nicholson, who made the mirror and correcting plate for the 180-mm Schmidt camera for the McDonald Observatory, told us how he overcame the difficulties in doing this work. Dr. Struve has written that a major discovery has been made with this camera and sent two prints of plates which were taken with it. One is a red sensitive plate and it shows a large diamond shaped nebula extending from Antares to *22* Scorpii. This is the first red nebulae known and is a very important discovery. Dr. Struve says that the star images obtained with short exposures with this camera are the best he has ever seen with any camera. We congratulate Carl on his workmanship and are glad to hear that he is planning to make another mirror and correcting plate for the McDonald Observatory.

On Saturday afternoon, July 25, we assembled at Joseph E. Boehm's summer home at Lake Geneva where we were met by a number of our friends from the Milwaukee Astronomical Association. In the evening we gathered around the telescopes. Joe's observatory with the fine 14-inch reflector is an example of what can be accomplished by an amateur. The telescope has an open fork mounting with cast iron base, fastened to a concrete pier which goes down to the gravel bed. It is equipped with a clock drive. It is a privilege to be allowed to use such an instrument. Some of the members brought portable instruments. F. W. Nach

had his 10-inch Cassegrainian and his 4-inch refractor, Arthur Peck had his 4½-inch refractor, and a member of the Milwaukee group had another fine refractor. All the instruments were in constant use till early morning.

WM. CALLUM, *Secretary.*

1319 W. 78th Street, Chicago, Illinois, August 19, 1936.

Cross-Hairs for your Telescope

A useful accessory which the amateur can make for his telescope is an instrument for aligning and placing cross-hairs, or wires, on the friction ring, or other receptacle used, in the eyepiece tube. The list of materials is very small; all one needs is a piece of steel, a bit of round brass stock, four large screws, and two small ones.

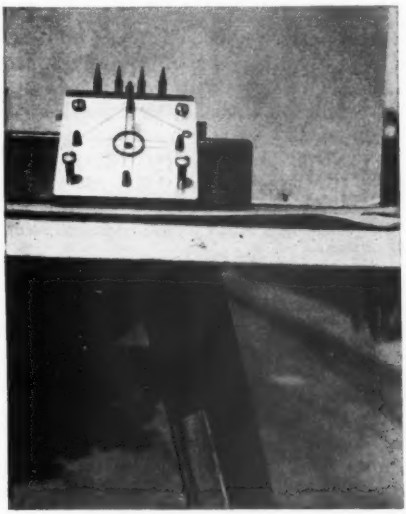


FIGURE 1

ALIGNMENT BLOCK FOR CROSS-HAIRS.

Showing actual setting, using the largest pillars and showing compound cross hairs in position on friction ring, ready for soldering. The smaller pillars are seen directly behind block on each side of the alignment center, used for checking.

There are a series of holes to drill in the steel and this work should be done first. Beginning at the corners these four holes are drilled and tapped to receive four ¼-inch filister head screws used for raising and lowering the steel table as will be explained later. The four holes midway between the corner holes should be drilled with the greatest degree of accuracy possible, as these are the four cardinal points on which the alignment depends. The writer did this work on a milling machine, but, believes that sufficient accuracy can be obtained on a drill press. The holes receive the stepped pillars around which the hairs or wires are wound. The two small holes drilled and tapped to receive the two round head machine screws secure the hairs, both at the beginning and at the end

of the work. The center pillar is used to check alignment and, as can be seen, is for the center hole, which should be drilled after first scribing circles for centering friction ring.

The only lathe work required is the turning of the stepped pillars, with steps ranging from 1/64-inch to 15/64-inch on ¼-inch round brass stock. This work was "miked" so as to assure uniformity on the eight stepped pillars.

The procedure is as follows and is illustrated in Figure 1. First the steel table is placed so that we have the two round headed machine screws in a horizontal position, one at the right and one at the left. We shall begin with the compound cross-hairs first and the largest size for the sake of convenience, and shall then call the top pillar hole north, the one at the right east, at the bottom south, at the left west. Then we place the larger of the stepped pillars in their respective places, secure the hair, or whatever material is used, beneath the screw at the left. One must remember that, when working with material measuring only a few thousandths of an inch, much care must be exercised, and one must see that the hand is always going in the right direction which is Right. As mentioned before, we begin by placing the wire underneath the head of the small screw and anchor it there, place the friction ring in position, take up the wire, pass along side of the west pillar, over the north pillar, down around the south pillar, up and over north pillar to the right around the east pillar, to the west around the west pillar back and completely around the east pillar to small screw, take up gently whatever slack there might be and secure beneath head of screw, being careful not to snap the wire when tightening the screw.

Now we have a perfect square within the circumference of the friction ring and, as can be seen, different sized, squares can be made by using the different sized steps in the pillars. Next we solder the wires to the friction ring, using a small soldering iron, which must be heated more often but is easier to manipulate than either an electric or the regular plumber's type. The iron used by the writer was a ten-cent type and proved an excellent medium. The friction ring should be tinned before placing on the steel table so that the actual soldering of the wires is done with the least amount of difficulty.

The procedure of the simple cross-hairs is slightly different, the reason for which will be explained later. First we place the four filister head screws in their respective places as also the smaller of the stepped pillars raise the table by turning the screws until the table is at such a height that the second step (next to the smallest) is at the same height as the top of the table itself; it is understood that the pillars should be pushed down while the table is coming up. Now anchor the wire beneath the head of the small screw at the left, pass along the west pillar up over the north pillar, down *to the left* and around the south pillar to the west pillar, around it, and to the right and around *the bottom* of the east pillar, up to the screw and secure it by tightening the screw. Now we have two wires crossing one another at right angles ready to be soldered the same as were the compound cross-hairs. Great care must also be exercised in removing extra solder from the edges of the friction ring so that the ring will slip into the eyepiece tube smoothly; do not touch cross wires to test for tension after soldering for fear of bending them while warm, it is best not to touch them at all except for cleaning and this should be done after soldering, when cool, and with a small camel's hair brush. If acid is used in soldering, ring and cross wires should be thoroughly rinsed and allowed to dry and then cleaned with the camel's hair brush. For any one who has never attempted a similar project, it is not a bad idea to practice the

alignment of the cross-hairs with fine thread for both the simple and compound types.

For this kind of alignment of cross-hairs heretofore two different instruments were necessary, one for the simple cross-hair and one for the compound, and for the compound as many different sized pins as the number of different sized squares desired. For the simple cross-hairs one drew the two lines at right angles and then drilled so that the hole just touched the line and always to the right of it, while for the compound type the holes were centered directly on the lines. One can easily see the advantage of the present instrument where both types are done on the same instrument and for the compound type fifteen different sizes are available with the two sized stepped pillars.

It must be remembered also that in placing the ring in the eyepiece tube, that for the two different types of eyepieces generally used, the ring in each has its respective place. In the Huyghens or negative eyepiece the cross-hairs are placed at the focal point between the primary and secondary lens of the eyepiece itself, while in the Ramsden or positive eyepiece the cross-hairs are placed just ahead of the secondary lens.

Care in the selecting of the wire is also important, it must be one that will stand both heat and corrosion.

The writer will gladly give further suggestions, if requested.

560 Broadway, Paterson, New Jersey. NEAL J. HEINES.

Asteroid Notes

By HUGH S. RICE

ADONIS

The nearest known planet to approach the earth is the asteroid that had the temporary designation 1936 CA. We mentioned in the preceding Notes that it was named Adonis by the discoverer, Delporte, as announced by the minor-planet headquarters of the world, the Astronomisches Rechen-Institut at Berlin-Dahlem. Why this object suddenly acquired the name Anteros we are still unable to find out. Prof. Dr. A. Kopff, head of the R.-I., in a personal letter to the writer states that neither the discoverer nor the R.-I. gave the name Anteros, which is therefore not the name at all, for this asteroid. The 3 planets coming nearest the earth in the light of present knowledge are therefore (in order): Adonis, Apollo, Amor. New planetoids are still being found. The latest new names now recognized by the R.-I. are the following, which were all named by the discoverer, Boyer: 1338 Duponta, 1339 Désagneauxa, 1340 Yvette, 1343 Nicole, 1344 Caubeta, and 1364 Safara.

RESIDUALS

The planet 387, Aquitania, which certain expert observers were unable to find this summer, even with a 12-inch telescope, was finally found, about 13′ off its predicted path in declination, and also thought to be fainter than predicted. However, the "residuals" or the observed values minus computed ones are often, in these asteroids, much less than this, depending on the accuracy of the ephemeris, the latter depending in turn upon elements based upon former observations. Some planets have more accurate orbits than others. Often the residuals are 0^m0 in right ascension, and 0′0 in declination, while occasionally they run high, as in the case of 898, Hildegard, observed in Simeis with residuals of $+16^m7$ and 89′.

Corrections to the R.-I. ephemerides when needed are published in the Beobachtungs-Zirkular der Astronomischen Nachrichten. They are based upon the latest observation data, and when used with the ephemerides make certain of the correct positions being known.

Iris and Vesta

Number 7, Iris, whose chart appeared in the last issue, is still good for observation this season. It is following the apparent path as laid out, but is a little fainter than predicted. It is circling around the pleiades and is well placed in Taurus for asteroid hunters. In October it is about $7^{M}.3$. Concerning the Big 4 of the asteroids, Pallas, Juno, and Ceres are not suitable for picking up now, but Vesta, the brightest of all, is becoming better placed as the time goes on. On October 7 it can be found about 2° south-west of ζ Geminorum, and on the 31st, about 4° west-south-west of the same star. It is hoped that these directions are clear: we could have said, in the former case, "south preceding", thus using a different terminology. A certain assiduous observer in Baltimore invariably locates these asteroids from our preliminary directions. Vesta's magnitude averages 7.7 for the month, and hence is easily discernible in a small glass. It begins to retrograde in the middle of the month.

Asteroids in Cetus

22, Kalliope, with predicted magnitude of $9^{M}.3$ should appear about 4° northeast of Mira on October 6; from that time until November 16, it will take a westward course for 10° of arc, and will probably be seen with small telescopes. Two other planets in Cetus may be seen, if they keep to their computed positions—18 Melpomene and 97 Klotho. We give herewith their ephemerides as calculated by the R.-I. It is interesting to note that they will come near conjunction in November. The values "var." signify the amount of variation in declination for each minute of right ascension by which they may possibly depart from the computed positions. If observers would write to this department telling of their experiences in finding these objects, we should then know more of their activities.

18 Melpomene $7^{M}.9$; var. +4′.0

		α h	α m	δ °	δ ′
1936 Oct.	15.0	2	48.1	—3	14
	23.0	2	42.9	—4	37
	31.0	2	36.8	—5	43
Nov.	8.0	2	30.6	—6	25
	16.0	2	25.1	—6	40
	24.0	2	21.0	—6	29

97 Klotho $9^{M}.1$; var. +3′.1

		α h	α m	δ °	δ ′
1936 Oct.	15.0	2	47.7	—1	37
	23.0	2	43.2	—3	6
	31.0	2	37.6	—4	24
Nov.	8.0	2	31.8	—5	26
	16.0	2	26.3	—6	7
	24.0	2	21.9	—6	24

Hayden Planetarium, American Museum of Natural History,
New York City, September 23, 1936.

General Notes

Professor Paul Stroobant, recently retired from the directorship of the Royal Observatory of Belgium, at Uccle, died at the age of 68 years, after a long period of illness.

Dr. S. Chandraeskhar, of Madras, has been appointed research associate in mathematical astronomy at the University of Chicago. (*Bulletin of the American Mathematical Society,* July, 1936.)

Dr. Bengt Stromgren, lecturer on astrophysics at the University of Copenhagen, has been appointed assistant professor of theoretical astrophysics at the University of Chicago. (*Bulletin of the American Mathematical Society,* July, 1936.)

Southern Stars.—No. 5 of Volume 2, for June-July, 1936, of this publication has been received. It is the official publication of *The Journal of the New Zealand Astronomical Society.* As usual, it contains a number of brief, well-selected, and clearly written papers on astronomy.

Leerman's Astronomical Laboratory, Baltimore, Maryland. Arrangements have been made by Dr. William H. Pargman, Dr. David Lovett, and Mr. Joseph Leerman to erect an observatory on the high mountain at Camp Airy, three miles from Thurmont, Maryland. A reflecting telescope with a mirror 12 inches in diameter, made and donated by Mr. Leerman, will be mounted there.

The Nantucket Maria Mitchell Association.—The thirty-fourth annual report of this association for the year 1935 has been published and distributed. Among the illustrations is a photograph of the ivy-covered observatory, and a plate showing a meteor trail made on December 4, 1935, terminating within the bowl of the Big Dipper. A large portion of the pamphlet is given to the report of the Astronomical Fellowship Committee of which Miss Annie J. Cannon is chairman, and of the report of the Director of the Observatory, Miss Margaret Harwood. The rest of the pamphlet is given to a report of the Director of Natural Science, the report of the Librarian, and various financial reports, concluding with a list of members.

The continued activity of this association is to be commended.

Dr. Orestes H. Caldwell, editor of "Radio Today," was elected to succeed Dr. Clyde Fisher as president of the Amateur Astronomers Association of New York City. This active association has already arranged and announced its program for the coming winter. The meetings for October and November will be held as follows:

Oct. 7—Dr. Orestes H. Caldwell, President AAA and Editor "Radio Today"—"Astronomy in the Service of Man."

Oct. 15—Joint Meeting with The American Institute.—Capt. C. S. McDowell, U.S.N.—"The Construction of Observatory and Mounting for the 200-inch Telescope."

Oct. 21—Dr. Clyde Fisher, Director of Hayden Planetarium.—"Siberia."

Nov. 4—Capt. J. F. Hellweg, Supt. U. S. Naval Observatory—"Time."

Nov. 18—Mr. T. R. Treadwell—"Atomic Structure and the Nature of Matter."

American Astronomical Society

At the meeting of the American Astronomical Society held at Cambridge, Mass., Sptember 2-5, Hisashi Kimura, director of the International Latitude Observatory at Mizusawa, Japan, and famous especially for his studies of the variation of latitude, was elected to honorary membership.

The following new members of the Council were elected: R. S. Dugan, Princeton, vice-president; J. C. Duncan, Wellesley, secretary; F. C. Jordan, Allegheny,

treasurer; D. B. McLaughlin, Michigan, S. L. Boothryod, Cornell, and Keivin Burns, Allegheny, councilors. Otto Struve, Yerkes, was elected to membership on the U. S. National Committee of the International Astronomical Union for the term 1937-40.

An extended report of the Cambridge meeting will be given in the next number of POPULAR ASTRONOMY.

Model of Moon Illustrates How Sunrise and Sunset Produce Phases

A three foot model of the Moon, constructed by Armand N. Spitz, of Newtown Square, Pennsylvania, serves to show the phases of the moon as they would be seen in a telescope, reproduced in relief the craters, mountain ranges, ray systems, seas and other features of lunar geography, so that the actual telescopic appearance of the moon, at any time of the month, may be shown. This arrangement is the basis of a demonstration entitled "One Day on the Moon," in the Wonderland of Science of The Franklin Institute, Philadelphia.

In order completely to understand the manner in which the sun rises and sets upon the moon, it would be necessary to pay daily visits to an observatory for more than three consecutive weeks, sometimes in the early evening twilight, sometimes at midnight, and sometimes at about dawn. If cloudy weather were to make it impossible to view the moon on any single evening, it would be necessary to wait for the next month to view that particular phase of the moon, and it is thus virtually impossible to perceive a steady progression of lunar sunrise and sunset. In addition, powerful telescopes directed upon the surface of the earth's satellite would show only a portion of the visible disc, because of the restricted field of vision of high powered eyepieces.

Mr. Spitz's model of the moon, believed to be the first of its type, will make possible the viewing of lunar sunrise and sunset in a single demonstration, independent of the necessity of making separate observations for the best part of a month. In addition, the audience will see the surface as it would appear through the eyepiece of a telescope, without having the field of view narrowed by the instrument.

The Franklin Institute, Philadelphia, Pennsylvania, September 10, 1936.

OBITUARY

DR. W. J. S. LOCKYER

William James Stewart Lockyer, the fifth son of the late Sir Norman Lockyer, was born on 1868 January 3. He received his early education at Cheltenham College, and thence proceeded to Trinity College, Cambridge, and the Royal College of Science, South Kensington. Later he went to the University of Göttingen where he received the degree of Ph.D. in 1896, the subject of his thesis being the irregular variable η Aquilae.

During the earlier part of his astronomical career, Lockyer assisted his father at the old Solar Physics Observatory at South Kensington, and with him took part in expeditions to observe the total eclipses of 1896, 1898, 1900, and 1905. Later he took sole charge of an expedition to New Zealand in 1911, but clouds prevented successful observations on this occasion. He was similarly unfortunate at the eclipses of 1927 and 1932.

On the removal of the Solar Physics Observatory to Cambridge in 1912, Lockyer's father went to live at Sidmouth, on the coast of South Devon, and here was founded the "Hill Observatory" in 1913. In 1916 the observatory was incorporated and has, since Sir Norman's death in 1920, been known as the Norman

Lockyer Observatory. On the death of his father Dr. Lockyer was named Director, and held this office until the day of his death, which came suddenly on 1936 July 15.

While acting as Director of the observatory Lockyer was engaged chiefly in the study of stars showing bright lines in their spectra, and some forty papers on these objects, mostly from his pen, were published in the *Monthly Notices of the Royal Astronomical Society* between 1920 and 1936.

Lockyer was at one time much interested in the possible relation between terrestrial meteorology, and solar activity, and, with his father, contributed papers on the subject to the Royal Society. He was a keen aeronaut, and, in the pre-airplane days, did some pioneer work in photographic surveying from balloons. During the Great War he served in various capacities as an officer in the Royal Naval Air Service.

Dr. Lockyer, who served on the Council of the Royal Astronomical Society for many years, and was Vice-President in 1933-1935, was a familiar figure at the Society's monthly meetings, and his jovial and cheerful presence will be much missed at those gatherings. His last visit to the United States was on the occasion of the meeting of the I.A.U. at Cambridge in 1932.

OBITUARY

JOHANNES HARTMANN

Professor Hartmann was born on January 11, 1865, at Erfurt, Germany. He was for many years astronomer at Potsdam Astrophysical Observatory where he did noble work in developing the modern spectrograph and its accessories. The methods now in use for controlling the temperature of spectrographs, for measuring the spectrograms, and for reducing them are all essentially as devised by Hartmann. He also invented the photometer and the spectrometer that bear his name, and perhaps his best known achievement was the invention of the Hartmann tests for investigating the character of telescopic objectives (lenses and mirrors) and for determining their errors. Hartmann was appointed director at Göttingen in 1909, and from 1921 to 1935 he was director of the National Observatory of the Argentine Republic at La Plata. He retired from this place in 1935 when he reached the age of 70. He died in Göttingen on September 13, 1936, after a long illness.

Book Reviews

Research Surveys of the Minor Planets, by A. O. Leuschner. (*Publications of the Lick Observatory,* Volume XIX, University of California Press, Berkeley, California.)

A more informative title of this volume is Research Surveys of the Orbits and Perturbations of Minor Planets 1 to 1091 from 1801.0 to 1929.5. Even this title is scarcely able to suggest the magnitude of this work. It is of octavo size and consists of twenty-two pages of printed introduction and general notes and 519 lithographed pages of data relative to the minor planets. This gives one an idea of the size of the finished volume, but one must still give his imagination considerable freedom in order to appreciate the labor involved in collecting and organizing this enormous amount of information.

As no attempt to collect Minor Planet data on so comprehensive a scale had been made previously, it was necessary for this purpose to scan the pages of every

astronomical publication since the discovery of the first of these objects in 1801. The list of abbreviations in the introduction to this work reveals 134 such sources.

The work has been in progress since about 1920. Preliminary Surveys of 21 planets were published in December, 1922, as Bulletin No. 25 of the National Research Council. This demonstrated the value of a complete survey which resulted in the present volume.

In order to appreciate the importance of this compilation of material it is necessary to see the volume itself. Even then the significance of it will not be fully realized except by those who in future years will wish to continue the large problem of keeping pace with the changing movements of these numerous bodies.

The volume will stand for centuries as a monumental contribution to this phase of astronomical science.

The Study of the History of Science, by George Sarton. (Harvard University Press, Cambridge, Mass. 1936. VI+ 75 p., 6 figs. Cloth, $1.50.)

The Study of the History of Mathematics, by George Sarton. (Harvard University Press, Cambridge, Mass. 1936. VI+ 113 p., 2 figs. Cloth, $1.50.)

Students of astronomy who are interested in the history of their science will find a considerable amount of useful information in these two books. The books are based on two inaugural lectures delivered by Dr. Sarton, at Harvard University, in October, 1935, and in February, 1936, respectively. The classified and annotated bibliographies are an important feature of these books; each volume has an index of persons and an index of titles of journals, serials, and institutions. Thus, the books offer both stimulating reading matter and reliable reference lists of permanent value.

A. Pogo.

Our Moon, by Philipp Fauth. (Dr. Hermann Eschenhagen, Breslau 10. Price 30 marks.)

About a century after the publication of the large treatise on the moon by Beer and Mädler and about a half century since the appearance of the volume by Neison, we have this important book embodying the results of observational work done during the last half century and bringing the subject up to date once more. Accompanying this work is a chart of the moon's surface upon which are delineated very many details. If we understand a statement of the publisher correctly, the author has in preparation a still more extensive chart of the moon which is to be issued by the same publisher later.

The comprehensiveness of the present volume is indicated somewhat by the fact that there are 592 printed pages. It is supplemented by sixteen full-page plates including photographs and diagrams of the moon, and a photograph of the telescope used by the author. More than thirty pages are devoted to indices of various kinds which make the locating of the discussion relating to any particular feature quite simple.

The writer of this brief review does not consider himself competent to make critical comment concerning the contents of the volume. From a cursory examination of it he feels justified in saying that the volume doubtless will fill an important place in the literature of the moon and will serve as a source book for those who wish to make further study of our satellite.

The author modestly concludes his work with these words:

"I have recorded here that which I have learned through a study of the moon during fifty-two years. A new book on the moon added to several recent ones in other languages must justify its existence. Perhaps the many references to lunar

relationships which up to this time were neither known nor anticipated will do this; also no less the more reliable numerical values for which the modern photographs are responsible. That there remain many imperfections no one knows better than the author."

Constellations, prepared by the Department of Astronomy of the Franklin Institute, Philadelphia. Thirty-five cents, postpaid.

This pamphlet of thirty-two pages is intended to answer questions which arise in the mind of everyone when he begins to consider the stars. These questions are made vocal many times by visitors to a planetarium. One who witnesses a constellation demonstration in a planetarium will doubtless hear within the period of less than one hour most of the facts set forth in this pamphlet. He will, however, not be able to remember them. It is then that the usefulness of this pamphlet as a handbook is shown.

The star charts are well arranged, the outstanding astronomical facts are clearly tabulated, a brief interesting account of the planetarium and a list of books for supplementary reading are included.

The pamphlet is very well suited to the purpose for which it is intended.

Red-Shifts in the Spectra of Nebulae is the title of a pamphlet of seventeen pages, comprising the Halley Lecture, delivered on May 8, 1934, by Dr. Edwin Hubble at Oxford University. The pamphlet is published by the Clarendon Press, Oxford, England, and a copy of it may be purchased for eighty cents.

A Key to the Stars, by R. van der Woolley. (Blackie and Son Limited, London and Glasgow. 5 shillings.)

The author of this small volume of less than 150 pages is chief astronomer at the Royal Observatory, Greenwich, and therefore, from the point of view of possession of facts and accessibility to the most recent developments in the science, there can be no question as to his qualifications for writing such a volume. The headings of the chapters which this professionally trained astronomer has thought suitable for presentation to the lay reader are: Time and Longitude; The Solar System; Stellar Distances and Magnitudes; The Temperatures of the Stars; The Composition of the Stars; Galaxies: Nebulae; Observatories.

These topics are clearly and succinctly presented, and, upon concluding the reading of this book, one will be well informed as to the status of the science of astronomy. The last chapter is somewhat unusual in books of this kind but is very appropriately given place as it restores the reader's interest in mundane affairs after having been carried into the inconceivably remote regions of space. The following paragraph, taken almost at random, is characteristic of the author's style and thought.

"We have to construct a star's life history from the assortment of stars as they are at present. It is generally felt that the spectral sequence is in some sense the life history of a star. Further, if the stars expend energy at the cost of decreasing their mass, the most massive stars must be the most recent and the least massive the oldest. The evolutionary scheme, or more properly, the life history of a typical star, then, seems to be something like this. The star starts off as a giant of type M, like Betelgeuse. It contracts and grows hotter, passing rapidly (for a star) up the spectral sequence to type A or B. This point of maximum surface temperature, when the star is something like Vega, is reached one aeon after the start (giving, temporarily, the name "aeon" to a hundred thousand million years).

From here onwards the star declines in surface temperature, mass, and luminosity, reaching the G type, like our sun, in a further fifty aeons or so. Its subsequent decay to type M is even more leisurely, and may occupy two thousand aeons. There is a suggestion that it is, at least in some cases, the final destiny of a star to become a white dwarf."

The compactness and authenticity of this volume commend it to all interested in the subject matter with which it deals.

History and Work of the Harvard Observatory, by Solon I. Bailey. (McGraw-Hill Book Company, New York City. $3.50.)

This is a long-delayed reference to an important volume issued in 1931. The writer of this note recently spent some time with this book and found it so fascinating, to one whose interests are in astronomical work, that he wishes at this late date to call it to the attention of the readers of POPULAR ASTRONOMY.

The work covers the period from the official establishing of the Harvard Observatory in 1839 until the year 1927. The author, having been a member of the staff of the Observatory from 1887 until the time of his death in 1931, was eminently qualified, by experience and by temperament, for the task. He was Phillips Professor of Astronomy from 1912 to 1925 and Professor Emeritus from 1925 to 1931.

The book is divided into three parts: Part I, Historical Outline; Part II, The Scientific Problems; Part III, Biographical Sketches.

We of the present generation who are familiar with the extensive work now in progress at the Harvard Observatory need a book of this kind to recall to us the fact that it too had its small beginnings. The stages through which the Observatory advanced and the persons whose influence and energy brought about its great and rapid expansion form the basis for a most captivating story.

In Part II, consisting of nine chapters, seventy-seven topics are listed and discussed, beginning with "The Brightness of the Sun," and ending with "Extra-Galactic Systems." One wishing an accurate, comprehensive account of the development of astronomical thought in America could not do better than to read carefully this part of the book under consideration.

In Part III many persons are mentioned as having been connected with the Observatory at some time during the period covered. But during the first seventy-seven years of its history there were only four directors. They were, with the years of service, as follows: William C. Bond, 20; George P. Bond, 6; Joseph Winlock, 9; Edward C. Pickering, 42. Among the long list of names of those persons who have had official or unofficial connection with this observatory are many which are prominent in the astronomical literature of this country.

The author of the volume was typical of the rare qualities found in many of the workers. At the time of his death one of his colleagues characterized him as "the courteous gentleman, the genial host, the understanding friend, the wise counsellor, and wholly delightful comrade." These attributes shine through the pages of this book and make the volume not only one of historical fact but also one of high literary value and warm personality.

The Dimensions and Structure of the Galaxy is the title of a pamphlet of thirty pages, comprising the Halley Lecture, delivered on June 5, 1935, by Dr. J. S. Plaskett at Oxford University. The pamphlet is published by the Clarendon Press, Oxford, England, and a copy of it may be purchased for seventy-five cents.

1. Hynek
2. Rosenberg

21. Mrs. Rufus
22. Sad-

41. Daghlian